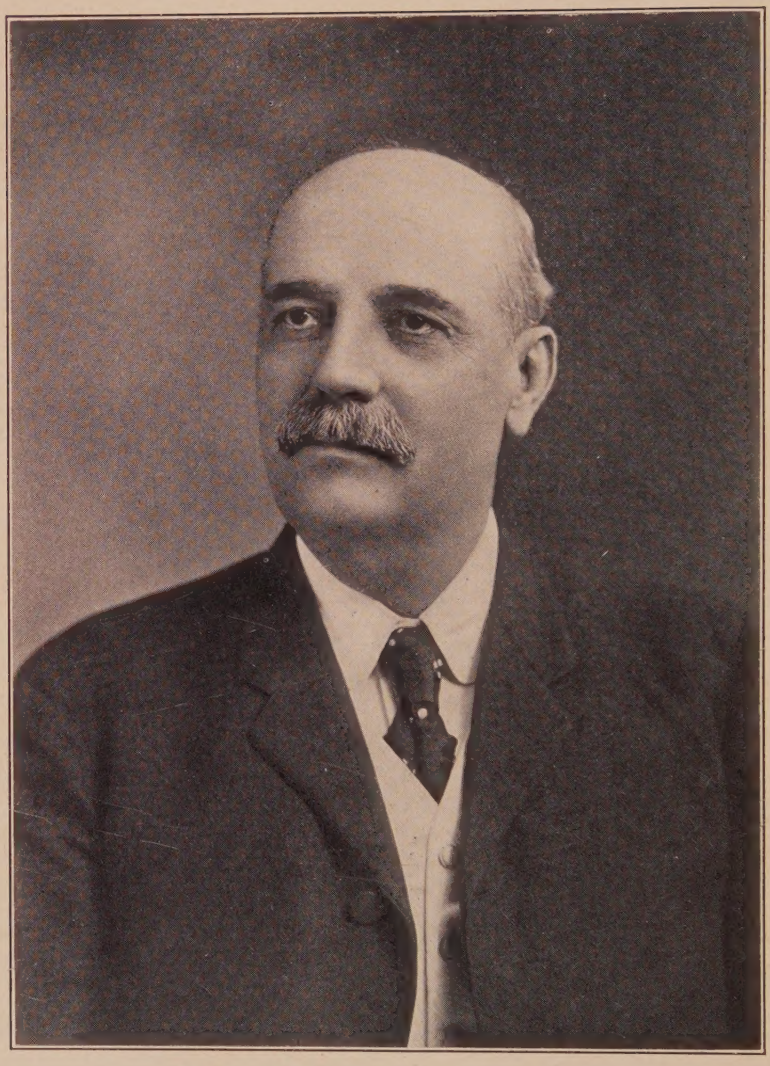
REPORT

OF THE

NEW JERSEY STATE MUSEUM

1907



JOHN FRANKLIN FORT, Governor.

ANNUAL REPORT

OF THE

New Jersey State Museum

including a list of the Specimens received
during the year

FINANCIAL REPORT

With a Report of the

MAMMALS OF NEW JERSEY

and a

SUPPLEMENT TO FORMER REPORTS.

FULLY ILLUSTRATED

1907

TRENTON, N. J.
MacCrellish & Quigley, State Printers.

1908.

PART I.

Commissioners of the New Jersey State Museum.

STATE SUPT. OF PUBLIC INSTRUCTION, CHARLES J. BAXTER, *President.*
STATE GEOLOGIST, HENRY B. KÜMMEL, *Secretary.*
PRESIDENT STATE BOARD OF AGRICULTURE, E. B. VOORHEES.
PRESIDENT OF THE SENATE, BLOOMFIELD H. MINCH.
SPEAKER OF THE HOUSE OF ASSEMBLY, EDGAR E. LETHBRIDGE.

SILAS R. MORSE, *Curator.*

Heads of the Several Departments of the New Jersey State Museum.

C. J. BAXTER, STATE SUPERINTENDENT OF PUBLIC INSTRUCTION,
Educational.

E. B. VOORHEES, RUTGERS COLLEGE,
Agriculture.

HENRY B. KÜMMEL, STATE GEOLOGIST,
Geology.

JOHN C. SMOCK, EX-STATE GEOLOGIST,
Forestry.

AUSTIN C. APGAR, STATE NORMAL SCHOOL,
Birds and Botany.

JOHN B. SMITH, STATE ENTOMOLOGIST,
Entomology.

JAMES T. MORGAN, DEPUTY OF BUREAU OF LABOR STATISTICS,
Manufactures.

WILLIAM H. WERNER, *Taxidermist of Museum.*
HERBERT M. LLOYD, SECRETARY OF GEOLOGICAL SURVEY,
Archæology.

Letter of Transmittal.

TRENTON, N. J., November 30th, 1907.

To the Honorable Edward C. Stokes, Governor of the State of New Jersey:

SIR—I have the honor to present, for the Commissioners of the New Jersey State Museum, the Annual Report, including the Report of the Mammals of New Jersey and The King Crab Fisheries of Cape May county, and further notes on the Amphibians and Reptiles of New Jersey.

SILAS R. MORSE,

Curator.

The Curator's Report.

The success of our last two Reports, "The Fishes of New Jersey" and "The Amphibians and Reptiles of New Jersey," both prepared by the same gentleman, Mr. Henry W. Fowler, has caused the Curator of the State Museum to take for this Report "The Mammals of New Jersey," which subject-matter has been prepared by Mr. Witmer Stone, of the Conservator Ornithological Section of the Academy of Natural Sciences of Philadelphia, a gentleman who has a national reputation as a Naturalist. To this is added a Supplement to the last two Reports edited by Henry W. Fowler.

The Report of 1906, "The Amphibians and Reptiles of New Jersey," is equal, if not superior, in some respects, to that of 1905 ("The Fishes of New Jersey"), and the printers, Messrs. MacCrellish & Quigley, have given us a report that has never been surpassed. This report is receiving general commendation from the public. It is a great addition to the State literature.

We feel that the present Report will be a credit not only to the New Jersey State Museum, its Commission and Curator, but to the State and all connected with it. We feel that the three reports will be of great value, educationally, to the State.

The object of the Commission and Curator of the Museum in establishing a purely first-class Museum is beginning to be appreciated by the authorities and by the citizens of the State. This is shown by the hearty support given us by the State officers, the Legislature and others interested in the cause of education. We expect to continue our efforts on the same lines.

Having been asked by the Jamestown Ter-Centennial Exposition Commission to prepare several exhibits for the Jamestown Exposition, our Commission consented to do so, and, conse-

quently, the Curator was instructed to prepare them. An account of these exhibits is given in another part of this Report.

It should be known that, by having a State Museum of this kind where the exhibits from the past Expositions are preserved, the expense to the State for making such exhibits has been very small compared with former exhibits. It is acknowledged that the exhibits of the State Museum at Jamestown were the best of their kind ever made by this State. This was done at a saving of many thousand dollars when compared with the former exhibits, and yet in the matter of awards we received as many or more than at other Expositions.

It has been our contention that these exhibits besides being a great benefit to the State as an educator, are also a great money saver to the State in preparing exhibits for the national exhibitions in which the State partcipates, as has been demonstrated in the preparation of the exhibit for the Jamestown Exposition.

Too much credit cannot be given to the New Jersey Jamestown Ter-Centennial Exposition Commission, especially to its Secretary, Col. Lewis T. Bryant, for their cordial support and in making these exhibits a grand success.

We also have to express our appreciation of the cordial assistance given us by all the school officers in the State in preparing the Comparative Educational Exhibit for the Jamestown Exposition, and we feel that it has been a great benefit to the schools of the State.

The New Jersey State Museum at the Ter-Centennial Exposition at Jamestown.

The State of New Jersey was the first to make an appropriation for this Exposition, which opened April 26th and closed November 31st, 1907. Governor Stokes appointed the following gentlemen to act as Commissioners to represent the State: Alfred Cooper, Cape May Court House, N. J.; Harry W. Leeds, Atlantic City, N. J.; D. Harry Chandler, Vineland, N. J.; James Harper Smith, Somerville, N. J.; Wallace M. Scudder, Newark, N. J.; Clarence E. Breckenridge, Maywood, N. J.; Richard W. Herbert, Wickatunk, N. J.; James T. MacMurray, Plainfield, N.

New Jersey State Museum Exhibit at Jamestown Exposition, West Aisle, Mammals and Birds.

J.; A. B. Leach, South Orange, N. J.; Dr. E. L. Stevenson, New Brunswick, N. J.; Dr. Thomas K. Reed, Atlantic City, N. J.

The Commission met and elected the following officers: Chief Commissioner, Clarence E. Breckenridge; Wallace M. Scudder, Vice-President; Col. Lewis T. Bryant, Secretary, Atlantic City, N. J.

The Commissioners left the matter of the Exhibit to the Secretary, Col. Lewis T. Bryant, except the Historical and Good Roads Exhibit, which they voted to have represented at the Exposition.

Mr. Francis B. Lee, State Historian, was selected to prepare the Historical Exhibit, and Road Commissioner Hutchinson was asked to prepare the Good Roads Exhibit. Col. Bryant asked Mr. Henry B. Kümmel, State Geologist, to prepare the Geological Exhibit, and Mr. Silas R. Morse, Curator of the State Museum, was asked to prepare the Educational Exhibit and Social Economy Exhibit.

Mr. Lee collected and installed the Historical Exhibit, which was a very interesting one, and was not only a credit to the State but to himself.

The Good Roads Exhibit was intended to be quite an extensive one, but after Mr. Hutchinson and the Secretary visited the Exposition grounds and found that the Exposition managers would not stand by their agreement with the New Jersey State Commissioners, and wanted to have the exhibit in an out-of-the-way place, it was decided not to build a sample road or building, but to make a small exhibit in the New Jersey Social Economy Exhibit. This was done. It consisted of illustrations showing roads before the State rebuilt them, and others after the good roads had been built. Also maps showing all of the roads made by the State up to that time, and samples of materials used in making roads, with reports and information prepared by the Road Commission. These maps, information and reports were distributed to those interested in good roads. For this exhibit a gold medal was awarded.

The following departments of the State Museum were represented and the exhibits prepared by the Curator, S. R. Morse:

The Comparative Educational.
The Fish, Birds and Mammals, etc.
The Forestry.
The insects injurious to vegetation.
The Exhibit "How to Exterminate Mosquitoes."
The Social Economy, comprising fifteen different State departments and institutions.

The Health Resort Exhibit was arranged by Secretary Col. Lewis T. Bryant.

THE MUSEUM EXHIBITS.

These exhibits included all of the State exhibits at the Jamestown Ter-Centennial Exposition, except the Historical and Health Resorts. They either came from the collections in the State Museum or were collected or prepared by it, and will become a part of it on being returned to the State House in Trenton at the close of the Exposition.

EXHIBITS IN THE STATE EXHIBIT PALACE.

The Geological Exhibit was prepared under the supervision of the State Geologist, Henry B. Kümmel. It occupies a prominent position in the space occupied by the New Jersey State Exhibits in the State's Exhibit Palace, the largest building on the grounds. The space is in the center of the building, being one of the best locations in it. The most of the exhibit was installed in two new plate-glass cases like the new ones in the State Museum, and will be placed in it when brought back to the State House.

THE INSECT EXHIBIT.

Beside the Exhibit "How to Exterminate Mosquitoes," 60 small cabinets of insects injurious to vegetation and other insects were shown. These exhibits contained 350 different varieties, making a very interesting and instructive collection, and one from

"How to Exterminate Mosquitoes"—West Aisle.
Part of the New Jersey State Museum at the Jamestown Exposition.

which much useful knowledge can be learned by all, and especially the farmer and horticulturalist.

MOSQUITO EXHIBIT.

The Exhibit "How to Exterminate Mosquitoes" was prepared by Prof. John B. Smith, State Entomologist, for the State Museum. It was first shown at the St. Louis Exposition in 1903, where it received a Grand Award. Prof. Smith received at the Jamestown Exposition a gold medal as colaborator. It received the highest award, a gold medal. The following is a description of the Mosquito Exhibit as it was shown at the Jamestown Exposition:

Mosquito Life Histories.

Box 1. The House Mosquito, *Culex pipiens* Linn.: figure of adult; figure of larva and details; 2 vials of male adults; 2 vials of female adults; 6 vials of larvæ in all stages; 2 vials of pupæ; 84 male adults pinned; 128 female adults pinned.

Box 2. The Little Black Mosquito, *Culex territans* Wlk.: figure of adult; figure of larva and details; 2 vials with male adults; 2 vials with female adults; 2 vials with pupæ; 6 vials with larvæ in all stages; 40 male adults pinned; 62 female adults pinned.

Box 3. The Unbanded Salt Marsh Mosquito, *Culex salinarius* Coq.: figure of larva and details; 2 vials with male adults; 2 vials with female adults; 6 vials showing larvæ in various stages; 2 vials with pupæ; 77 male adults pinned; 70 female adults pinned.

Box 4. The Woodland Pool Mosquito, *Culex canadensis* Theob.: figure of adult; figure of larva and details; figures of larval heads showing variation in maculation; 2 vials with male adults; 2 vials with female adults; 1 vial with eggs; 2 vials with pupæ; 5 vials with larvæ in various stages; 63 male adults pinned; 50 female adults pinned.

Box 5. The Swamp Mosquito, *Culex sylvestris* Theob.: figure of adult; figure of larva and details; figures of larval heads show-

ing variation in maculation; 2 vials with male adults; 2 vials with female adults; 6 vials of larvæ in various stages; 2 vials with pupæ; 55 male adults pinned; 146 female adults pinned.

Box 6. The Brown Woods Mosquito, *Culex cantans* Meig., and the Golden-brown Mosquito, *Culex aurifer* Coq.: (1) *C. cantans,* figure of adult; figure of larva and details; 1 vial with pupæ; 2 vials with larvæ; 21 male adults pinned; 18 female adults pinned. (2) *C. aurifer,* figure of adult; figure of larva and details; 1 vial with adults; 1 vial with larvæ; 1 vial with pupæ; 10 male adults pinned; 12 female adults pinned.

Box 7. The Tree-hole Mosquito, *Culex triseriatus* Say.; The Three-lined Mosquito, *Culex trivittatus* Coq., and The White-Dotted Mosquito, *Culex restuans* Theob.: (1) *C. triseriatus,* figure of larva and details; 1 vial with larvæ and pupæ; 8 male adults pinned; 8 female adults pinned. (2) *C. trivittatus,* figure of larva and details; 9 male adults pinned; 18 female adults pinned. (3) *C. restuans,* figure of adult with details of adult and larva; 2 vials with male adults; 2 vials with female adults; 1 vial with pupæ; 3 vials with larvæ in all stages; 24 male adults pinned; 27 female adults pinned.

Box 8. The Ring-legged Salt Marsh Mosquito, *Culex sollicitans* Wlk.: figure of larva and details; 2 vials with male adults; 2 vials with female adults; 6 vials with larvæ in all stages; 2 vials with pupæ; 66 male adults pinned; 92 female adults pinned.

Box 9. The Small Salt Marsh Mosquito, *Culex tæniorhynchus* Wied.: figure of adult; figure of larva and details; 2 vials with male adults; 2 vials with female adults; 1 vial with eggs; 1 vial with pupæ; 5 vials with larvæ in various stages; 63 male adults pinned; 70 female adults pinned.

Box 10. The Brown Salt Marsh Mosquito, *Culex cantator* Coq.: figure of adult; figure of larva and details; 2 vials with male adults; 2 vials with female adults; 2 vials with pupæ; 6 vials with larvæ in various stages; 44 male adults pinned; 101 female adults pinned.

Box 11. Salt Marsh Mosquitoes: 3 figures of larval heads of *Culex sollicitans,* 3 of *C. tæniorhynchus* and 3 of *C. cantator* showing extent of maculation in each species; 1 vial of larval

Health Resorts Exhibit.

heads of *sollicitans;* 1 vial of larval heads of *tæniorhynchus;* 1 vial of larval heads of *cantator;* mosquito eggs on lint; 4 vials of *sollicitans* adults parasitized by *Agamomeris culicis* Stiles, and also worms dissected out; 3 vials of *sollicitans* larvæ attacked by disease; 1 vial with female *sollicitans* abdomens distended with eggs; 1 vial with female *cantator* abdomens distended with eggs.

Box 12. *Anopheles maculipennis* Meig., and *Anopheles punctipennis* Say.: (1) *A. maculipennis,* figures of male and female adults; 1 vial with male adults; 1 vial with female adults; 1 vial with pupæ; 2 vials with larvæ; 35 female adults pinned. (2) *A. punctipennis,* figure of adult; figure of larva and details; 1 vial with male adults; 1 vial with female adults; 1 vial with pupæ; 2 vials with larvæ; 30 female adults pinned.

Box 13. *Anopheles crucians* Wied.: figure of adult; figure of eggs; figures of pupæ showing differences between *Anopheles* and *Culex;* figure of larva and details; 4 vials with female adults; 2 vials with pupæ; 4 vials with larvæ; 93 female adults pinned.

Box 14. The Fringe-legged Mosquito, *Psorophora ciliata* Fabr.: figure of adult; figure of larva and details; 1 vial with male adults; 1 vial with female adults; 2 vials with pupæ; 2 vials with larvæ; 11 male adults pinned; 40 female adults pinned.

Box 15. The Pitcher-Plant Mosquito, *Wyeomyia smithii* Coq.: figure of larva and details; 1 vial with male adults; 2 vials with female adults; 1 vial with eggs; 1 vial with pupæ; 4 vials with larvæ in all stages; 3 vials with the leaves of pitcher plants; 50 adults representing both sexes.

Mosquito Enemies.

Box 16. Some Salt-Marsh Minnows: *Cyprinodon variegatus,* 3 vials containing 11 specimens; *Fundulus majalis,* 3 vials containing 6 specimens; *Fundulus heteroclitus,* 3 vials containing 5 specimens; 1 vial with 2 specimens of *Fundulus majalis* and 1 specimen of *Fundulus heteroclitus* showing differences in banding.

Box 17. Coast Line Minnows: *Menidia notata,* 3 vials containing 13 specimens; *Gambusia affinis,* 3 vials containing 11 specimens; *Mugil curena,* 2 vials containing 6 specimens; *Lucania parva,* 2 vials containing 9 specimens.

Box 18. Some Fresh Water Fishes: *Fundulus diaphanus,* 2 vials containing specimens; common gold fish, 2 vials containing specimens; little sticklebacks, 2 vials containing specimens; Roach or Shriner, 3 vials containing specimens.

Box 19. Diving Beetles and their Larvæ: *Dytiscus verticalis,* 3 vials with larvæ and 18 beetles; *Graphoderus liberus,* 14 beetles; *Thermonectes basilaris,* 12 beetles; *Acilius semisulcatus,* 2 vials with larvæ and 16 beetles; *Rhantus binotatus,* 2 vials with larvæ and 16 beetles; *Agabus æruginosus,* 18 beetles; *Hydroporus modestus,* 81 beetles; *Coptotomus interrogatus,* 72 beetles; *Laccophilus maculosus,* 36 beetles; 3 vials of indetermined larvæ.

Box 20. Whirligig Beetles or Gyrinidæ and Aquatic Hemiptera or Water Bugs: *Dineutes discolor,* 24 specimens; *Dineutes vittatus,* 21 specimens; *Dineutes discolor,* 24 specimens; *Benacus griseus,* 6 specimens; *Belostoma americana,* 6 specimens; *Notonecta variabilis,* 18 specimens; *Notonecta undulata,* 27 specimens; *Zaitha fluminea,* 18 specimens; *Corixa* species, 18 specimens; *Ranatra fusca,* 5 specimens; *Hygrotrechus remigis,* 14 specimens.

Box 21. Dragon Flies or Odonata: *Epiæschna heros,* 2 vials with larvæ and 6 adults; *Lestes rectangularis,* 2 vials with larvæ and 3 adults; *Anax junius,* 3 vials with larvæ and 3 adults.

Box 22. Dragon Flies or Odonata: *Pachydiplax longipennis,* 4 vials with larvæ and 7 adults; *Libellula basalis,* 2 vials with larvæ and 8 adults; *Libellula cyanea,* 1 vial with larvæ and 3 adults; *Libellula semifascia,* 1 vial with larvæ and 2 adults; *Mesothemis simplicicollis,* 1 vial with larvæ and 5 adults.

Box 23. Dragon Flies or Odonata: *Microthyria berenice,* 1 vial with larvæ and 6 adults; *Sympetrum rubicundulum,* 1 vial with larvæ and 6 adults; *Lestes rectangularis,* 2 vials with larvæ and 9 adults; *Ischnura verticalis,* 4 vials with larvæ and 12 adults *Ischnura posita,* 3 vials with larvæ and 12 adults.

Packing the Museum Exhibits to ship at the close of the Jamestown Exposition.

Museum Exhibits packed ready to load.

Repellants and Larvicides.

Box 24. Smokes and Smudges: 1 vial with Chinese punk; 5 packages Moskuitoons; 4 packages Lister's Fumigator; 4 Sulphur Candles; 1 vial of Pyrethrum; 1 vial of Datura Stramonium.

Box 25. Repellants: Vials of Oil of Pennyroyal; Oil of tar; Cottonseed oil; Oil of Citronella; Oil of Lavender. Cures: Camphenol; Phenol Sodique; Water of Ammonia; Tobacco; Bicarbonate of Soda.

Box 26. Larvicides: Vials of Crude Petroleum; Kerosene; Fuel Oil; Chloronaptholeum; Phinotas Oil; Cresol; Creolin; Formalin; Permanganate of Potash; Flake Napthalin.

Colored Charts.

1. Wing of a typical *Culex;* head of *Anopheles* showing arrangement of scales; 3 wing scales of Anopheles; group of 11 characteristic scales found on mosquitoes.

2. Larva of Anopheles from side and above; head from side and anal segments of larva; antennæ of two species showing differences; a mandible, maxillary palpus and a mentum of larva.

3. Resting position of *Culex sollicitans* and *Anopheles maculipennis;* male antennal joint, female antennal joint, tip of beak with lancets, male anterior claw, female anterior claw and clasper of genitalia of *Culex pipiens.*

4. A pupa of *Culex* and *Anopheles* showing differences.

5. *Anopheles* in the act of biting and the mosquito digestive system.

6. Stomach of *Anopheles* showing zygotes of the malarial organism on the surface; two cross sections showing zygotes in position on the surface of the stomach.

7. *Anopheles* salivary glands: one entire, one longitudinal section and one cross section of set of glands, and a cross section to show the blasts or sporozoits in position in the gland.

8. Head and mouth structures of *Anopheles maculipennis:* entire head of female from side; entire head of male from above;

head of female, showing how lancets rest in the tip of the beak; female labium, palpus and palpifer with tips of lancinia and palpifer separate.

9. Larva of *Culex pipiens;* egg-boat of same on surface of water with young emerging; cluster of single eggs of same, separate; egg of *Anopheles,* 2 views; egg of *C. canadensis,* whole and with cap tipped by issuing larva; egg of *C. sollicitans,* 2 views; egg of *W. smithii,* whole and with cap tipped; egg of *P. ciliata.*

10 and 11. Twenty-seven figures illustrating the growth and development of the malarial parasite, the sexual stages, conjugation and also the vegetative or asexual reproduction.

12. The Yellow Fever Mosquito: showing the male from the side, female from above and anterior claw of each; larva at surface of water, egg from side and top, and also 4 details of adult structure, 4 of larval structure and 2 of pupal structure.

13. Explanatory chart of the entire mosquito exhibit.

THE MOUNTED BIRDS.

There were four large plate-glass cabinets containing mounted New Jersey birds, 4 small cabinets and 50 glass globes each containing a group of male and female with their nest and eggs, and in some the young also. These groups are very natural and are to illustrate natural bird-life and surroundings. The 2 large cabinets of owls, nests, eggs and young are a new acquisition to the Museum collection, having never been placed in the Museum Hall. They make a very nice addition to it.

The method adopted by the Museum Commission in grouping the birds was to make this part of the collection an educational one as much as possible. That of the birds and all of the grouping was done by the State Taxidermist, William H. Werner, who is one of the best in this line of work.

THE FISH EXHIBIT.

This consisted of mounted fish, showing some of the kinds of fish found in New Jersey. They are fine specimens and do credit to the taxidermist who did the work of preparing them, as

Geological Exhibit, Jamestown Exposition, East Side.

Geological Exhibit, Jamestown Exposition, West Side.

well as to the Museum. There were no better specimens to be found at the Exposition, and, consequently, attracted much attention and favorable comment.

GEOLOGICAL SURVEY.

The different ores and minerals in the cases are so grouped as to show the different ores mined, and also the different products secured during the concentration of the same. The samples exhibited show this fairly well.

The iron ores in the case show the best grade of ore as mined, while the concentrates show the poorer grade and the different products that are secured during the concentration of the lean ore to a high-grade ore.

The zinc ores also show the different ores as mined, and the concentrates show the different products that they secure during the concentration. Some of these products are of little value, as in the case of the tailings of white limestone which is shown as one of the end products, while the other product is the high-grade zinc ore freed from all detrimental impurities. Since the zinc ores are found in the white limestone, we have placed the limestone next to the zinc ores; also the gneiss and mine rock occupy the same position in regard to the iron ores.

The cement case shows the cement rock as mined, the different ingredients added to it to make cement, and also the finished product. There is also some test specimens showing the method by which the cement is tested for its physical properties.

The building stones, copper ores, glass sands and marls will need very little explanation.

The zinc minerals, which are chiefly of scientific interest, are in a case by themselves, as are also the various minerals found in the trap rock series.

MAMMALS.

There are two large cabinets containing groups of mammals, including the old and young. Eleven small ones, with groups of male and female. They, with young, represent the only mam-

mals found in New Jersey. These groups are, as far as possible, intended to represent the specimens in their natural surroundings, on the same plan as the birds are arranged.

SOCIAL ECONOMY.

This exhibit was installed in the Social Economy Building. It consists of 15 different State departments and State institutions, as follows:

Department of Labor and Statistics, Board of Health, Department of Good Roads, State Museum, "How to Exterminate Mosquitoes," Industrial School for Colored Youth at Bordentown, State School for Boys at Jamesburg, State School for Girls at Trenton, School for the Deaf, Trenton; State Institute for Feeble-Minded Girls and Women at Vineland; State Institute for Feeble-Minded Boys and Girls, Vineland; School of Industrial Arts at Trenton, State Circulating Libraries, and Department of Banking and Insurance.

The exhibit of the Department of Labor and Statistics consisted of large photographs, 33 in a New Jersey Exhibit cabinet showing the betterment for the employes of some of the manufactures of the State; a full set of reports and 10,000 books for free distribution explaining what is being done in the State for the laboring classes.

The Board of Health Exhibit consisted of illustrations and descriptions showing what it is doing for the advancement of health in the State.

The Good Roads Exhibit has a large number of illustrations to show the roads before and after their improvement was made; samples of different materials used in the construction of the road; reports explaining how they are constructed, the manner of paying for them, what the State has contributed toward them, etc. Several hundred bound books are for free distribution. The maps show the roads that the State has made since it began to appropriate money for this purpose. New Jersey was one of the first to begin this great work and has spent many hundred thou-

Social Economy Exhibit from the State Museum at Jamestown Exposition.

Front View of the N. J. Social Economy Exhibit, Representing 15 different State Departments and Institutions at Jamestown Exposition from the New Jersey State Museum.

sands of dollars for it—$300,000 for the present year. New Jersey is noted for its good roads. This exhibit was awarded a gold medal.

The Mosquito Exhibit came from the State Museum and consisted of one cabinet of 33 frames, 22 by 28, containing illustrations and explanations how to exterminate mosquitoes. It was used as a cross reference to the main exhibit in the State Museum, which was installed in the State's Exhibit Building. A description of these places is given in this report. This was prepared by Prof. John B. Smith, of the New Jersey Experimental Station, who is also State Entomologist.

THE INDUSTRIAL SCHOOL FOR COLORED YOUTH, BORDENTOWN.

This exhibit contains work done by the pupils in the different branches of the school, with charts showing the increase of the colored race in the different counties of the State, and much other useful knowledge.

THE SCHOOL FOR THE DEAF.

This exhibit is a very interesting one and shows the institute to be in an excellent condition. It consists of work done by the pupils in general academic departments, printing, manual training and industrial departments. The printing, needle-work, dressmaking, shoemaking, etc., show what excellent work is being done by the school.

STATE INSTITUTE FOR FEEBLE-MINDED GIRLS AND WOMEN.

This exhibit is a very interesting one, showing what kindness and system can do for this class. This exhibit consists of such work done in the different departments of the school as could be exhibited, and shows the good which is being done for these unfortunates. The work is excellent. Dr. Mary J. Dunlap is Principal. It received a silver medal.

STATE INSTITUTE FOR FEEBLE-MINDED BOYS AND GIRLS.

This is another institute similar to the one for girls and women, but it includes boys as well as girls. It is under the charge of Edward R. Johnstone.

The exhibit consists of photographs of the pupils on entering the school and at the time the exhibit was prepared, with first work done and at the present time, by the same pupil. This truly shows what advancement the pupil has made. It is a new method and a thoroughly good one.

SCHOOL OF INDUSTRIAL ARTS AT TRENTON.

This is one of only two State schools of its kind in the State. The exhibit consists of art work done by the pupils, for which a silver medal was received.

THE DEPARTMENT OF BANKING AND INSURANCE.

This exhibit was prepared by this Department, of which David O. Watkins is Chief. It consists of copies of the State law, giving the institutions under these heads, constitution and by-laws governing the same, photographs of some of the principal State banks and trust companies, also of homes and other buildings erected by the loans from the building and loan associations of this State.

EXHIBIT OF THE HEALTH RESORTS OF NEW JERSEY.

This is the first exhibit of this kind ever made, and included paintings, large photographs and small photographs, showing views of the different attractions of the resorts in swing-frame cabinets of Long Branch, Asbury Park, Lakewood, Atlantic City and Wildwood. Many thousands of attractive circulars and

Comparative Educational Exhibit—Rear Alcove at the Jamestown Exposition.

First Alcove of the Comparative Education Exhibit at Jamestown Exposition.

booklets from these different resorts have been distributed to those attending the exhibit. This exhibit secured a gold medal.

COMPARATIVE EDUCATIONAL EXHIBIT.

This is the first exhibit of the kind ever shown by any State, and has proven very successful and instructive, having been studied by hundreds of teachers and educators. It has done much good, as it showed the advancement the State of New Jersey had made in the past thirty-one years in the educational line. It consisted of work shown at Philadelphia in 1876, at New Orleans in 1885, at Chicago in 1893, at Buffalo in 1901, at Charleston in 1901–1902, and at St. Louis in 1903. The new work showed conclusively that great improvement has been made since the World's Exhibit at Philadelphia in 1876 up to 1907 under the supervision of the several State Superintendents and the State Board of Education.

Great credit is due to the City and County Superintendents and the able teachers for this success of our school system.

This exhibit received a gold medal as a whole and twelve silver medals for city schools having work there.

The Development of the Pennsylvania Rails and Tracks in its New Jersey Roads, Shown by Sections of the Rails, etc.

Collected by Samuel L. Roberts, of Bordentown, N. J., and presented by him to the New Jersey State Museum in 1907.

This is a very valuable addition to the Museum, and one that is appreciated by the Commission and the public. It consists of sections of all-rails, spikes, etc., and complete sets of joint fastenings, as far as possible, used by the roads now under the control

of the Pennsylvania Railroad in the State of New Jersey. Mr. Roberts made the collection for the Pennsylvania Railroad Company. He was 30 years in making it. Full rails were shown at the Columbian Exposition at Chicago in 1893. The first of these rails was laid in the year 1831, near Bordentown.

Mr. Samuel L. Roberts, of Bordentown, N. J., who made the collection, has worked for the Pennsylvania Railroad Company for over 30 years, and, being over 70 years of age, has been retired on a pension.

The first strap-rail, which was laid at Bordentown by the Camden and South Amboy Railroad and Transportation Company, weighed 8½ pounds to the yard. It was also used on the Delaware and Atlantic Railroad in 1832; also between Kinkora and New Lisbon. The first strap-rail used in the Camden and Amboy in 1831 weighed 8½ pounds to a yard. A small amount of T-rail was used in 1831 and weighed 36 to 40 pounds to the yard. In 1842 still another T-rail, weighing 62 pounds to a yard. In 1848, the large T-rail, weighing 92 pounds to a yard, was used, but the height of this rail made it undesirable, and it was soon discarded.

Thus the collection shows the advancement of the rails and manner of fastening them up to the time the collection was made. At first stone was used instead of ties, as now, which is shown in the exhibit. There are only five of these collections—two kept by the Pennsylvania Railroad Company, one by the Field Columbia Exhibit, Chicago, one by R. P. Showden, Engineer of the Amboy Division, and the other is in the New Jersey State Museum.

The strap and T-rails first used were brought from England. In 1846 some of the rails used in the New Jersey Railroad were rolled in the city of Trenton, N. J., 62 pounds to the yard. The John Brown rail, 57½ pounds to the yard, used in 1866, was one of the best rails ever used by the New Jersey Railroad.

The standard rail of 60 pounds to the yard was first used in 1876.

In 1893 a new standard rail was used of 100 pounds to the yard, and it is still the standard. Many different kinds of rails and of different weights are shown by this excellent exhibit, as

Prospective View of the Educational Exhibit at the Jamestown Exposition.

well as the different couplings and spikes, showing the gradual advancement in the utility and durability of the same. This is considered one of the most valuable exhibits in the Museum.

No doubt, had not the State Museum been established this valuable exhibit would, like many others, been lost to the State. New Jersey is rich in its historical and other valuable exhibits. They should be preserved by the State, which is one of the objects of the State Museum.

This only goes to show how many valuable exhibits the State could have had if it had established a Museum years ago. Many excellent exhibits have gone from New Jersey to other States for want of a place in the State to preserve them.

The Museum Commission wish to thus publicly extend their thanks and that of the State to Mr. Roberts for his valuable contribution. They also wish to state that they will be pleased to receive at any time any contributions to the Museum that will be in any way an aid to making the State Museum truly educational.

The Commission have started an historical branch of the Museum. They have received some valuable exhibits, presented to the Museum by the Jamestown Ter-Centennial Commission from the collection made by Mr. Francis B. Lee for that Exposition.

Contributions for this department will be gladly received and appreciated.

MORE ROOM SADLY NEEDED.

The present rooms are overcrowded and not large enough for the present exhibits, many of which cannot be shown for want of space. We are continually adding new specimens to our collection. In order to carry out the plans of the Museum Commission it will be absolutely necessary to have more room. This is more urgent since one of the rooms in which was displayed a part of our educational exhibit had to be taken from us in order to make room for the new wing to the State House. As no new room or rooms has or have been assigned to us for exhibits, we are only able to display a small part of the educational work.

WHAT IS NEEDED.

There should be a new building built especially for the State Museum, Geological Survey and kindred departments. At one of the meetings of the Museum Commission it was voted to ask the State House Commission to consider this proposition. The building of the new wing to the State House, which was greatly needed for offices, of course deferred building a new Museum wing or building, but we trust the State House Commission will give favorable consideration to our request at as early a date as possible. The Museum Commission are anxious to add a historical department to the Museum, now that a large part of the historical exhibit prepared by Hon. Francis B. Lee for the Jamestown Exposition has been given to the Museum Commission by the New Jersey Jamestown Ter-Centennial Exposition Commission.

There are many rich and valuable historical relics in the State that would be gladly given to the State if it had a safe and convenient place to keep and display them. This should be provided.

The work for the past year has required much time, patience and labor. To arrange, plan, pack, ship, unpack and instate so many exhibits in so successful a manner is no small job. Then to repack, ship, unload and reinstate them in the State Museum can only be appreciated by doing it.

As a whole, little damage was done to the exhibits sent to the Jamestown Exposition.

When everything is arranged in the Museum, although our space is limited, it will be more attractive than ever before.

In closing, we must again thank the members of the State Museum Commission and the State House Commission for the uniform courtesy we have received from them. We also wish to express our thanks to the New Jersey Ter-Centennial Commission, its President, Hon Clarence E. Breckenridge, and its Secretary, Col. Lewis T. Bryant, for the kind treatment received at their hands.

Front View of the N. J. Comparative Educational Exhibit at the Jamestown Exposition, 1907.

NEW COLLECTIONS.

The following special groups of birds' nests, eggs and young were procured from Mr. William H. Werner by the Museum Commission and sent to the Jamestown Exposition with the other New Jersey State Museum Exhibits, and will be returned to the State House, Trenton, and installed in the Museum. Two large glass cabinets, containing the following specimens:

Pair of snowy owls (Nyctea nyctea), male and female and nest and eggs, with natural surroundings.

Great horned owl, male and female, nest and eggs, with natural surroundings.

Hawk owl, male and female, nest and eggs, with natural suroundings.

Wilson's long-eared owl, male and female, nest and eggs, with natural surroundings.

Saw-whet owl, male and female, nest and eggs, with natural surroundings.

All of the above with painted background.

Four small cabinets of bird groups:

The sparrow hawks, male and female, nest, eggs and young, with natural surroundings.

Clapper rail or mud hen, female and young, and a white or Albino specimen, with natural surroundings.

Sharp-shinned hawk, female and five young and nest, with natural surroundings.

Purple galinule, male and female and six young, with natural surroundings.

NEW SPECIMENS IN THE STATE MUSEUM DURING THE YEAR.

Mounted Birds.

Caspian tern.
Forster's tern.
Common tern.
Black skimmer.
American golden plover.
Red-backed sandpiper.
American long-eared owl (young).
Chuck-will's widow.
Nighthawk.
Redpoll.
Varied thrush.
Puffin.
Common tern.
Semipalmated sandpiper.
Spotted sandpiper.
Great horned owl.
Hairy woodpecker.
Purple grackle.
Lapland longspur.
Savanna sparrow.
White-eyed vireo.
Louisiana water-thrush.
Mourning warbler.
Wilson's warbler.
American pipit.
Winter wren.
Sandbill cranes (male and female).
Swan.
Coot.

Rail.
Fox sparrow.
2 ravens.
King eider duck.
Medallion loon.
Osprey.
Four specimens of owls, with nests, eggs and natural surroundings.
American eiders.
American hawk owl.
American sparrow hawk.
Blue-winged teal.
Ruby-crowned kinglet.
Brown-headed nuthatch.
Connecticut warbler.
Pine warbler.
Worm-eating warbler.
American crossbill.
Purple grackle.
Least fly-catcher.
American coot.
King eider.
Shoveller.
Sandpiper.
2 scaup ducks.

Eggs.

Burnnich's murre.
American herring gull.
Ring-billed gull.
Cabot's tern.
Forster's tern.
Common tern.
Arctic tern.
Black skimmer.
Gannet.
Mallard.
Widegeon.
Louisiana heron.
Little blue heron.
Black-crowned night heron.
King rail.
Florida gallinule.
Willet.
Spotted sandpiper.
Oyster-catcher.
Bob white.
Ruffed grouse.
Ground dove.
Turkey vulture.
Cooper's hawk.
Red-shouldered hawk.
Broad-winged hawk.
Sparrow hawk.
American barn owl.
American long-eared owl.
Barred owl.
Screech owl.
Roadrunner.
Belted kingfisher.
Hairy woodpecker.
Red-bellied woodpecker.
Chuck-will's widow.
Scissor-tailed fly-catcher.
Wood pewee.
Traill's fly-catcher.
Starling.
Yellow-headed blackbird.
Red-winged blackbird.
Orchard oriole.
Purple grackle.
Bronzes grackle.
Boat-tailed grackle.
American goldfinch.
Vesper sparrow.
Grasshopper sparrow.
Seaside sparrow.
Lark sparrow.
White-crowned sparrow.
Swamp sparrow.
Summer tanager.
Purple martin.
Bank swallow.
Rough-winged swallow.
White-eyed vireo.
Prothonotary warbler.
Mockingbird.
Carolina wren.
House wren.
Chickadee.
Blue-gray gnat-catcher.
Wood thrush.
Wilson's thrush.
Bluebird.
Puffin.
Razor-billed auk.
Kittiwake gull.

Part of the N. J. State Museum at Jamestown Exposition, 1907.

Black-crowned night heron.
King rail.
Florida gallinule.
Wilson's phalarope.
Willet.
Bartramian sandpiper.
Killdeer.
Wilson's plover.
Turkey vulture.
Marsh hawk.
Barred owl.
Burrowing owl.
Chuck-will's widow.
American magpie.
American crow.
Savanna sparrow.
Western lark sparrow.
Lark bunting.
Warbling vireo.
Black and white warbler.
Prothonotary warbler.
Royal tern.
Bewick's wren.
Arctic tern.
Roseate tern.
Black tern.
Black skimmer.
American white pelican.
American eider.
American avocet.
Black-necked stilt.
Northern downy woodpecker.
Scissor-tailed fly-catcher.
Arkansas kingbird.
Purple grackle.
Boat-tailed grackle.
Vesper sparrow.
Grasshopper sparrow.
Sharp-tailed sparrow.
Prairie warbler.
Carolina wren.
House wren.
Common tern.
Horned grebe.
Pied-bill grebe.
Puffin.
Black guillemot.
Murre.
Ring-bill gull.
Least tern.
Fulmar.
Stormy petrel.
Leaches petrel.
Gannet.
American white pelican.
Brown pelican.
Hooded merganser.
Cadwall.
Shoveller.
American eider.
Canada goose.
Least bittern.

Nest and Set.

Olive-backed thrush.
Wilson's thrush.
Hooded warbler.
Louisiana water-thrush.
Prairie warbler.
Chestnut-sided warbler.
Magnolia warbler.
White-eyed vireo.
Yellow-throated vireo.
Loggerhead shrike.
Cedar waxwing.
Towhee.
Swamp sparrow.
Field sparrow.
Grasshopper sparrow.

Nests and Eggs.

American goldfinch.
Purple finch.
Orchard oriole.
Least fly-catcher.
Green-crested Acadian fly-catcher.
Wood pewee.
Phoebe.
White-throated sparrow.
Wood pewee.
Acadian fly-catcher.
Traill's fly-catcher.
Least fly-catcher.
Prairie horned lark.
Orchard oriole.
Towhee.
Yellow-throated vireo.
Magnolia warbler.

MOUNTED SPECIMENS.

8-foot rattlesnake.
Gray squirrel.
Two mounted wildcats.
One doe's head.
One buck's head.
One buck's head.
Weasel.
Deer head.

Mounted Fish.

Black fish.
Two land-locked salmon.
Togue.

10 insect cases for the Museum.
"American Woods," Parts IX and X, st. 4.
2 glass cabinet cases.
4 cases on easels with painted background, complete sets of birds, male and female, nest, eggs and young.

APPROPRIATION BY THE LEGISLATURE, 1907.

For additional allowance for the Commission, to acquire new material and other incidentals, expenses, sixteen hundred dollars.

Total amount appropriated, ... $1,600 00

FINANCIAL STATEMENT.

T. G. Earle & Son,	$1 98
Ernest H. Short,	52 56
United States Express Company,	26 89
Adams Express Company,	3 51
Ernest H. Short,	30 32
Romeyn B. Hough,	15 00
Earl S. Norcross,	24 50
D. E. Heywood,	37 00
New Jersey School-Church Furniture Company,	20 00
Adams Express Company,	8 35
United States Express Company,	5 24
Petry's Express,	3 95
New Jersey School-Church Furniture Co.,	21 00
Henry W. Fowler,	100 00
United States Express Company,	16 91
Walter D. Hinds,	27 00
William H. Werner,	500 00
S. R. Morse,	56 95
Norcross & James,	46 00
Ernest H. Short,	31 66
Stenographer's services,	350 00
New Jersey School-Church Furniture Co.,	221 18
	$1,600 00

Fish and Game Exhibit at the Jamestown Expostion from N. J. State Museum.

THE MUSEUM REPORTS AND HOW THEY ARE DISTRIBUTED.

There has been such a demand for the Reports of the State Museum that we have to use much care in the distribution of them. The last two Reports, 1905, "The Fishes of New Jersey," and 1906, "The Amphibians and Reptiles of New Jersey," are such valuable ones we have tried to place them where they will do the most good. Nearly fifty copies of each have been sent to the United States Departments and libraries at Washington, D. C.

Copies have been sent to each State Library, and 300 copies given to State Librarian Henry C. Buchanan to send to the public libraries of New Jersey. Copies have also been sent to nearly all the City and County Superintendents for the Public School Libraries in the city and county schools, taking about 700 volumes of each Report for the school libraries alone. Copies have been sent to many of the colleges and scientific schools in the United States, as well as to persons interested in the subjects treated of in the Reports. Copies have also been sent to nearly all of the State and other Museums in the United States, to the head of all the State Departments, State officers, including Senators, Representatives, judges, etc.

Several of the first Reports published by the State Museum have been exhausted, especially the Report of 1903, "The Birds of New Jersey." The Report for 1905, "The Fishes of New Jersey," is about exhausted, only a few copies remaining, which are kept for exchange. Our exchange list has increased quite rapidly, and we are receiving some valuable works for our Museum Library, which we are trying to make one of much value to the State. We believe we have, as a rule, placed the Reports where they will do the most good.

From the many letters of commendation for our Reports we feel that in the matter of Reports we have done our State much good, as well as the subjects taken up in the Reports. The Report for 1907, which is in the hands of the printers, "The Mammals of New Jersey," will be a companion to the last two reports, and one of much value.

That the Museum Reports are appreciated and valued is, we think, shown by trying to procure copies at the old book-stores. We thus far have been unable to procure one copy of the Report of 1903, after searching for it in several stores in this State, New York city and Philadelphia.

When our series of Reports on Natural History is completed we think New Jersey will have as complete a set of reports as any State.

PART II.

THE MAMMALS OF NEW JERSEY.

BY WITMER STONE,

Academy of Natural Sciences, Philadelphia, Pa.

PREFACE.

The mammals of any region are fewer in number of species than any of the other groups of vertebrates, except the Batrachia, which, however, are usually associated familiarly with the reptiles. The apparent scarcity of mammals is moreover exaggerated by their nocturnal habits and ability in concealing themselves, and in the course of an ordinary walk one usually sees only a few species, such as squirrels and rabbits.

Many of the larger species have been exterminated years ago, being either predatory or valuable for food and fur, and the preservation of the remaining animals of the latter class can only be accomplished by the support of the general public in enforcing the wise game laws that the Legislature has passed. Owing to the small number of species and the similarity of the New Jersey mammals to those of other eastern states comparatively little has been published upon them until quite recently.

The principal papers on the subject are as follows:

Beesley, Thomas. List of the Larger Wild Animals of the County of Cape May. <Geology of the County of Cape May, State of New Jersey, Trenton, 1857, p. 137.

A list of 18 species, with very brief annotations.

Abbott, Charles C. Catalogue of Vertebrate Animals of New Jersey. <Appendix E., Geology of New Jersey; George H. Cook, Newark, 1868, Mammals, pp. 751–760.

A fully annotated list of 47 species.

Abbott, Charles C. A Naturalist's Rambles about Home, New York, 1885. <Appendix, List of Mammals, Birds, Reptiles, Batrachians and Fishes of Mercer County, New Jersey, Mammals, pp. 447–451.

Notes on 26 species.

Nelson, Julius. Descriptive Catalogue of the Vertebrates of New Jersey. (A revision of Dr. Abbott's Catalogue of 1868.) <Final Report of the State Zoölogist, Vol. II, Pt. II, Trenton, 1890, Mammals, pp. 494-518.

A list of 62 species, with descriptions and notes compiled from various sources. Some of the species are admittedly unknown

from New Jersey and are given on grounds of their possible occurrence.

RHOADS, SAMUEL N. A Contribution to the Mammalogy of Northern New Jersey. <Proceedings Academy of Natural Sciences, Philadelphia, 1897, pp. 23–33.

Valuable notes upon 41 species from a section of the State hitherto unstudied by the mammalogist.

RHOADS, SAMUEL N. The Mammals of Pennsylvania and New Jersey, Philadelphia, 1903.

This elaborate scientific and historical monograph is the best and most comprehensive State report on mammals that has yet appeared. It completely covers the subject and leaves practically nothing to be said on the New Jersey species. It should be in the hands of everyone interested in the subject.

The above works, as well as various other papers scattered through periodicals have been consulted in preparing the present work and to the authors of all, especially to Mr. Rhoads, the writer would express his obligations. Further acknowledgements should be made to the Academy of Natural Sciences of Philadelphia for the opportunity of using the library of the institution and studying its collection of mammals which includes the New Jersey material collected by both Mr. Rhoads and the author together with other specimens from the State.

The descriptions are drawn up from notes compiled by the writer when preparing the volume on *American Animals** in conjunction with William E. Cram. The plates are from Audubon and Bachman's *Quadrupeds of North America*, reports of the *United States National Museum, Smithsonian Institution* and *United States Fish Commission* and from specimens in the Academy's collection.

Finally, I wish to express my obligation to Mr. S. R. Morse, Curator of the State Museum, at Trenton, for many courtesies and much aid in publishing the present report.

WITMER STONE,
Academy of Natural Sciences
of Philadelphia, Pa.

October 30th, 1907.

* Doubleday, Page & Company, 1902.

The Mammals of New Jersey.

Mammals, the majority of which are more popularly known as quadrupeds, form the highest class of Vertebrate or "backboned" animals.

Most of them are four-footed and covered with hair, and are terrestrial in their habits, such as the dog, the horse and the mouse, but two groups that belong to the mammalia differ materially from the rest, both in external appearance and in habit.

The bats, while looking not unlike mice so far as their head and body are concerned, have their hands modified into membranous wings which are carried down the sides of the body so as to include the hind legs and tail, thus, admirably fitting these little animals for their aërial life.

The whales and dolphins, on the other hand, are fitted for a life in the ocean. They are practically hairless, with no trace of hind limbs, the fore limbs modified into flippers, the tail broad and flat like that of a fish, only that it is transverse instead of vertical. These beasts look little like the hairy quadrupeds of the land, and it is not surprising that in the popular mind they are associated with the fish. As a matter of fact their skeletal structure is like that of the quadrupeds, while they have warm blood and suckle their young, all of which are essential characteristics of the class of mammals. The existing mammals fall into three groups:

(1) The *Prototheria,* curious remnants of an earlier fauna, now only represented by the Duckbill and Spiny Anteater of Australia, mammals with horny bills like birds and which lay eggs somewhat like those of certain reptiles.

(2) The *Marsupialia* or pouched mammals also an ancient group represented by the Kangaroos and other Australian mammals and by the opossums of North and South America.

(3) The *Eutheria* or modern mammals comprising all the familiar species found to-day in all parts of the world, except the Australian region.

In New Jersey we have, of course, no representatives of the *Prototheria,* while the *Marsupialia* are represented only by the common oppossum. Of the *Eutheria,* we have numerous examples, although several of the orders are entirely wanting, as for instance, those comprising the elephants, sloths and monkeys. Remains of some of these, however, occur as fossils, in deposits in different parts of the State; the most familiar being the great mastodon, a close relative of the elephant, whose gigantic skull, teeth and tusks are now and then brought to light when excavations are being made in the earth. The several orders of mammals that are represented in the New Jersey fauna may be distinguished as follows:

a. Young born at a very early stage of development and reared in a pouch on the belly of the female. MARSUPIALIA (Opossum)

aa. Female not pouched. EUTHERIA

b. Aquatic, with no hind legs; fore legs modified into flippers for swimming. CETACEA (Whales, etc.)

bb. Terrestrial (except seals and bats), all four limbs developed, and body thickly covered with hair.

c. Nails developed into hoofs. UNGULATA (Deer, etc.)

cc. Nails compressed and hooked, forming claws.

d. Incisor (or front) teeth very prominent, two in each jaw, a gap on each side separating them from the molars or back teeth. GLIRES (Rats, etc.)

dd. Incisors small, generally more than two; canine (or eye) teeth present, filling the gap between the incisors and molars.

e. Fore feet developed into wings. CHIROPTERA (Bats.)

ee. Fore feet normal.

f. Canines not prominent. INSECTIVORA (Shrews, etc.)

ff. Canines prominent. CARNIVORA (Wild Cat, Seals, etc.)

Order MARSUPIALIA.

Pouched Mammals.

This order is represented in America only by the opossums, and but one species occurs north of Mexico.

Family DIDELPHIDÆ.

Opossums.

Genus Didelphis, Linnæus.

Didelphis virginiana Kerr.

Virginia Opossum.

Plate I.

Length, 27 inches; hair long and rather coarse; general color, grayish white; long overlying hairs, white; under fur white, with black tips; legs brownish black; feet black, toes white, head, throat and underparts white, ears naked, black with whitish tips; tail prehensile, nearly naked, black at the base, passing into dull flesh color.

This familiar animal is abundant all over the southern states, and ranges well up the Mississippi Valley and up the Atlantic slope as far as southern New York. Its normal range is coincident with the upper border of the Carolinian fauna, which runs approximately from New York to Trenton, and which marks also the northern limit of the opossum's favorite food, the persimmon, and, in a general way, that of his mortal enemy, the country negro.

The opossum, however, occurs farther north in the State in reduced numbers, and Mr. Rhoads records individuals secured in Bergen, Hudson and Passaic counties, in all of which, however, it is regarded as rare.

Besides persimmons and other fruit the opossum eats almost everything that may come in its way, not hesitating to enter the pigeon loft or chicken house, though the damage thus done is not usually of importance. The young opossums when born are about half and inch in length, and are at once placed in the pouch, where they attach themselves to the teats, and remain until more fully developed. When six or eight inches long they may often be seen swarming out over the back of their parent, their little naked tails twisted around hers, or hanging head down with her from some horizontal limb.

Didelphis virginiana Abbott, Cook's Geol. of N. J., 1868, p. 755.—Abbott, A Naturalist's Rambles, 1885, p. 451.—Rhoads, Mam. Pa. and N. J., 1903, p. 8.—Beesley, Geol. Cape May Co., 1857, p. 137.

Didelphis marsupialis virginiana Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 24.

Order CETACEA.

Whales and Dolphins.

These inhabitants of the ocean only occasionally come within the limits of the State of New Jersey, and except when cast up dead on our coasts there is little chance of identifying them with certainty. In early colonial days whaling was practiced on our coasts, but whales are now rare, and several species of porpoises or dolphins are the only Cetaceans of regular occurrence in New Jersey waters. These are, however, abundant, especially off Cape May, where they may be seen at almost any time, in the summer especially, plunging and rising again just beyond the breakers; occasionally, too, they come into the larger bays along the coast. The salient characteristics of the several families of Cetaceans to which our North Atlantic species belong, are as follows:

a. Size large (30 to 85 feet long), mouth enormous, teeth absent, but the upper jaw provided with long strips of whale bone.

BALÆNIDÆ (Whale-bone Whales.)

aa. Size medium or large (10 to 80 feet), large teeth along the lower jaw but absent from the upper. PHYSETERIDÆ (Sperm Whales.)

aaa. Size medium (20 to 30 feet), one tooth on each side of the lower jaw, or teeth absent; a narrow projecting snout. ZIPHIIDÆ (Bottle-nosed Whales.)

aaaa. Size small (5 to 15 feet), teeth numerous in both jaws, head in some species rounded in front, in others with a projecting snout. DELPHINIDÆ (Dolphins and Porpoises.)

Family BALÆNIDÆ.

Whale-Bone Whales.

This family comprises all the large whales with the exception of the Sperm Whale, and they are generally known as Toothless Whales or Whalebone Whales. In the very early stages of their development small teeth are formed, but these entirely disappear before birth.

The mouth of these whales is filled with thin, heavy plates of baleen or whalebone attached crosswise down each side of the roof of the mouth. The inner edges are much lacerated forming a sort of seive, so that when the tongue is pressed up against the baleen the water in the mouth is forced through and passes out at the lips leaving any small animals or other food stranded on the seive.

There is a popular idea that water is forced out of the mouth through the nostril or "blow hole," but this is an error; the so-called "spout" of the whale being due merely to the condensation of moisture in the discharged breath, perhaps combined with some water which may be thrown up if the discharge begins while the head is still slightly below the surface.

Our Whalebone Whales belong to three genera, which may be distinguished as follows:

a. No fin on the back, throat not furrowed, upper jaw highly arched and narrow. BALAENA

aa. Dorsal fin present, throat deeply furrowed longitudinally, upper jaw not arched, skull flat and broad.

b. Back humped, flippers very long and scalloped on the edges. MEGAPTERA

bb. Back not humped, flippers moderate, not scalloped. BALAENOPTERA

Genus Balæna Linnæus.

Right Whales.

Balaena glacialis Bonaterre.

Black Whale.

Plate 2.

Head enormous, equal to one-third of the total length; highly arched above the level of the back; mouth cavity large and whalebone very long. Bones of the neck always fused together. Color black, sometimes slightly varied with white below. Length 50 to 60 feet.

This whale variously known as the Black Whale, Atlantic Right Whale and Nordcaper is distributed all over the North Atlantic, and was one of the species much hunted by whalers of the north. It was undoubtedly much more common on the New Jersey coast in former years than it is to-day. Several specimens have been recorded on our coasts. In George Ord's American Zöology, Guthrie's Geography, 1815, p. 292, he says: "A young whale of this species was taken in the Delaware in the vicinity of the Falls (*i. e.*, Trenton) in the latter part of the year 1814, and exhibited at Philadelphia." Another one came up the river in 1862 and was captured opposite Philadelphia. It was presented to the Academy of Natural Sciences of that city by Mr. George Davidson, and its skeleton may still be seen in the Museum. It measured 37 feet in length. Still another was captured off the New Jersey coast by a crew of experienced Egg Harbor Whalers in the spring of 1882 and was brought to New York City where it was exhibited for several weeks.

A skeleton in the Rutger's College Museum is said by Mr. Rhoads to be of this species, probably the one whose capture is described in an article in the *New York Sun*, reprinted in *Forest and Stream*, July 4th, 1874, p. 267. It came up the Raritan nearly to South Amboy, where it was "shot with a rifle, hacked with an axe, and at last killed with a harpoon!"

Balæna cisarctica Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 168.—Abbott, Cook's Geol. of N. J., 1868, p. 759.—Holder, Bull. Amer. Mus. Nat. Hist., I., p. 106.—Anon., *Forest and Stream,* 1874, p. 267.

Balæna physalis Ord, Guthrie's Geography, 1815, p. 292.

Balæna glacialis Rhoads, Mam. Pa. and N. J., 1903, p. 10.

Genus MEGAPTERA Gray.

Hump-Backed Whales.

Megaptera nodosa (Bonnaterre).

New England Hump-Backed Whale.

PLATE 3.

Similar to the Fin-backed Whales, but with the back strongly convex and the flippers very long and scalloped on the edges. Sooty black above; beneath spotted, and streaked with white on throat, chest and belly; length, 46 feet.

While there is no positive record of this species stranding or being caught on the coast of New Jersey, it has been taken as far south as Virginia and from Massachusetts to Newfoundland, so that it may occur on our seaboard at any time.

Genus BALÆNOPTERA Lacépedè.

Fin-Backed Whales.

Balaenoptera physalus (Linnæus).

Common Fin-Backed Whale; Rorqual.

PLATE 4, FIG. 1.

Length, 60 feet. Dark slate, nearly black above, gray on the sides and white below. Head assymetrically colored, left side of upper jaw and upper part of lower jaw dark, right side of lower

jaw and anterior part of upper jaw white. Whalebone on left side dark, but anterior part on right side whitish.

This seems to be the most abundant whale in this part of the Atlantic and is the one most frequently cast ashore, though we can find few records of its actual occurrence on the New Jersey coast.

Mr. S. N. Rhoads found a jaw bone of a whale at Beach Haven about 1885, which he refers to this species, and a cranium was washed up at Cape May in 1906, which was presented to the Academy of Natural Sciences of Philadelphia by Mr. Christopher Gallegher. Another is reported by Dr. F. W. True as stranded at Fenwick's Island Life Saving Station, Delaware, May 7th, 1896.

Doubtless many of the whales obtained by the early whalers of Cape May belonged to this species.

Balæna mysticetus Cassin, Hist. Delaware County, Pa., 1862, p. 434.—Rhoads, Mam. of Penna. and N. J., 1903, p. 12.

Balaenoptera acuto-rostrata Lacépedè.

Little Piked Whale; Least Rorqual.

PLATE 5.

Length, 25 feet. More heavily built than the preceding, dorsal fin larger in proportion, its height five per cent. of total length; colors similar, joined rather abruptly on the flanks, flippers white over basal half.

George Ord states in Guthrie's Geography, 1815, p. 292, that a "Pike-headed Whale" was caught some years since in the Delaware near Reedy Island. Mr. Rhoads refers this, with some doubt, to this species. Equally doubtful is a specimen washed up on Long Beach, opposite Westecunk Creek in the fall of 1866 (Cope, Proceedings Acad. Nat. Sci. Phila., 1868, p. 221).

These whales were no doubt Fin-backs, but their specific identity will always remain in doubt. This species is, however, to be looked for on our coast.

Balænoptera acuto-rostrata Cope, Proc. Acad. Nat. Sci. Phila., 1868, p. 221.—Rhoads, Mam. Pa. and N. J., 1903, p. 11.

Balaenoptera musculus (Linnæus.)

Great Blue Whale, Sulphurbottom.

PLATE 4, FIG. 2.

Length, 60 to 70 feet. Head broader and more obtuse than the other species of the genus, dorsal fin short, only one per cent. of total length. Color, mottled gray throughout.

This whale, the largest of living animals, has occurred at least once on the New Jersey coast, a specimen having been stranded at Ocean City on October 1st, 1891, the skeleton of which is now in the Museum of the Academy of Natural Sciences of Philadelphia. It measured 67 feet in length, and is described by Prof. E. D. Cope in the Proceedings of the Academy, 1891, p. 474.

Balænoptera musculus Cope, Proc. Acad. Nat. Sci. Phila., 1891, p. 474.—Rhoads, Mam. Pa. and N. J., 1903, p. 13.

Family PHYSETERIDÆ.

SPERM WHALES.

These whales are distinguished from the Whalebone Whales by the presence of regular teeth in the lower jaw (but none in the upper), by the absence of whalebone, and by the high vertical forehead. There are two genera:

a. Teeth large and heavy, 22 to 24 on each side; size of animal very large. PHYSETER

aa. Teeth slender, curved, 4 to 14 on each side; size of animal small. KOGIA

Genus PHYSETER Linnæus.

Sperm Whales.

Physeter macrocephalus Linnæus.

Sperm Whale; Cachalot.

PLATE 6.

Length 60 to 80 feet. Head oblong, level with the back above, square and truncate in front, forming nearly one-third of the

total length of the animal, lower jaw shallow and very narrow, armed with 20-24 large teeth on each side, back with several humps. Color black, lighter below.

This great toothed whale resembles the Whalebone Whales in size. Its nostrils are placed farther forward and its "spout" issues diagonally instead of vertically, thus enabling whalers to identify it at long distances. Its food consists largely of squids, and the "ambergris" discharged from its intestines and found floating on the water is highly prized as an article of perfume. The Cachalot is rare on the New Jersey coast, and is said to seldom enter shallow waters. According to Dr. F. W. True, several bones of this speces were found at Cape May, August, 1882, and a young male 18 feet 6 inches long was obtained on Brigantine Beach, May 4th, 1900 (Rhoads, Mammals of Pa. and N. J.).

Physeter macrocephalus Rhoads, Mam. Pa. and N. J., 1903, p. 14.

Genus Kogia Gray.

Kogia breviceps (DeBlainville).

Pigmy Sperm Whale.

Plate 7.

Length, 10-15 feet. Similar to the preceding, but very much smaller, with slender, curved teeth, and a fin on the back.

Although generally regarded as a rare animal, quite a number of specimens have been secured on the New Jersey coast.

Three specimens now in the U. S. National Museum, are as follows (from Rhoads' Mammals Pa. and N. J.):

No. 15222 Barnegat City, October 24th, 1885; female.

No. 15223 Loveladies Island, October 25th, 1885; male.

No. 22893 Atlantic City, April, 1888; male.

Mr. Rhoads also mentions another male stranded at Corson's Inlet, Sea Isle City, February 18th, 1894, and another fine male

is in the Museum of the Wistar Institute, which I examined in the flesh. It was captured November 2d, 1899.

Kogia breviceps Rhoads, Mam. Pa. and N. J., 1903, p. 15.

Kogia Goodei True Nat. Hist. Useful Aquat. Anim., 1884, pl. 2.

Family ZIPHIIDÆ.

Bottle-Nosed Whales.

These whales are intermediate in size, between the large whales and the dolphins. They have protruding snouts and never more than two teeth. The front of the skull enlarges with age and sometimes protrudes over the snout.

Three genera occur in the north Atlantic:

a. No teeth visible. HYPEROODON
aa. One tooth on each side of the lower jaw.
b. Teeth at the front of the jaw. ZIPHIUS
bb. Teeth at the middle of the jaw in male. (Female toothless.) MESOPLODON

Genus Hyperoodon Lacépedè.

Hyperoodon rostratus (Müller).

Bottle-Nosed Whale.

Plate 8.

Length, 20 feet. Head nearly vertical in front, beak prominent, a depression around the blow-hole, flippers and dorsal fin moderate. No teeth visible, although one may be found on each side of the lower jaw in front, buried in the gums. Color, blackish, head somewhat lighter below. This species is common in the northern oceans, but the only record on the New Jersey coast is one mentioned by DeKay in his Zoology of New York, I., p. 131, taken in the lower bay in 1822.

Genus Ziphius Cuvier.

Ziphius cavirostris Cuvier.

Ziphius Whale, Cuvier's Whale.

Length, 15-20 feet. Similar to the preceding, but with the teeth at the front of the lower jaw usually visible. Three of the

vertebræ of the neck are separate, while in *Hyperoodon* they are all fused. Color, light stone gray, darker on the belly. Dr. F. W. True records the stranding of a specimen of this whale at Barnegat City, October 3d, 1883, an adult female measuring 19 feet 4 inches. This is the only record for our Atlantic coast (see Science, 1883, p. 540).

Ziphius cavirostris True, Science, 1883, p. 540. Rhoads, Mam. Pa. and N. J., 1903, p. 16.

Genus Mesoplodon Gervais.

Mesoplodon bidens (Sowerby).

Cowfish, Sowerby's Whale.

Length, 12-16 feet. Similar to the last, but male with a tooth on each side of the lower jaw at about the middle, female toothless, skin very smooth, black all over with occasional lighter blotches. A male specimen, twelve and a half feet long, was stranded at Atlantic City, March 18th, 1889, and its skeleton is preserved in the U. S. National Museum.

Micropteron bidens Turner, Proc. Roy. Phys. Soc. Edin., X (1889), p. 13.

Mesoplodon bidens Rhoads, Mam. Pa. and N. J., 1903, p. 17.

Family DELPHINIDÆ.

Dolphins and Porpoises.

This family comprises all the smaller cetaceans. All of our species have a dorsal fin, and all except the Grampus have numerous sharp teeth in both jaws.

The popular name dolphin strictly applies to those species with a projecting snout, while the porpoises have a rounded head without a snout. As is frequently the case, however, the names have become hopelessly misapplied, and the most plentiful dolphin on our coast is usually known as the porpoise.

The several genera that occur on the New Jersey coast may be distinguished as follows:

a. Teeth 6 to 14 on each side in the lower jaw only. GRAMPUS
aa. Teeth in both jaws.
b. Teeth few, 8 to 13 on each side above and below.
c. Confined to the front portion of the jaws, 8 to 10 on each side. GLOBICEPHALA
cc. Distributed all along the jaws, 10 to 13 on each side. ORCINUS
bb. Teeth numerous, 22 to 50 on each side above and below.
d. A projecting snout.
e. Palatine area—*i. e.*, roof of the mouth—flat.
f. Teeth 22 on each side above and below. TURSIOPS
ff. Teeth 37 above and 34 below on each side. PRODELPHINUS
ee. Palatine area with longitudinal ridge in middle, a deep groove on each side; teeth 47 to 50 above, 46 to 51 below, on each side. DELPHINUS
dd. No projecting snout, head rounded, teeth 26 above and below on each side. PHOCAENA

Genus Tursiops Gervais.

Tursiops truncatus (Montagu).

Bottle-Nosed Dolphin, "Porpoise."

Plate 9.

Length, 9 feet. Stout, forehead sloping; beak short and depressed, dorsal fin about midway between the nose and tip of the tail. Color plumbeous gray, lighter on the sides and white beneath. Teeth, 22 on a side in each jaw.

This is apparently the commonest species on the New Jersey coast, and the schools of "porpoises" which we see rising and plunging again with such rhythmic motion just beyond the line of the breakers are probably, for the most part, this species.

They travel in schools sometimes of considerable numbers, old and young together, and feed upon various species of fish. Regular porpoise fisheries have been established at certain points on our Atlantic coast, notably at Cape Hatteras, where, in the season of 1884-5, according to Dr. True, no less than 1,200 were captured and oil extracted from them, the average yield in winter being 8 gallons to each animal. Mr. Rhoads states on Dr. True's authority, that a company was incorporated in New Jer-

sey, February 1st, 1894, for the purpose of catching porpoises at Cape May but, though many were taken, the enterprise was not successful.

Two skeletons of Cape May specimens are in the United States National Museum, and another from a specimen caught in a fisherman's seine at Red Bank on the Delaware, early in the sixties, is in the Academy of Natural Sciences of Philadelphia.

Tursiops tursio Rhoads, Mam. Pa. and N. J., 1903, p. 17.

Genus DELPHINUS Linnæus.

Delphinus delphis Linnæus.

Common Dolphin.

PLATE 10, FIG. 1.

Length, 7 feet. Beak longer and narrower than in the preceding. Color variable, back black, sides gray, underparts white; a black ring around the eye and a black line to the beak, usually several dusky stripes on the sides. Teeth 47 to 50 on each side in the upper jaw and 46 to 51 below.

This species is apparently not common on our Atlantic coast but has been taken in New York Harbor and at Woods' Hole. The only New Jersey specimen with which I am acquainted, is a female, the skeleton of which is in the Academy of Natural Sciences of Philadelphia, secured at Ocean City in 1894.

Delphinus delphis Abbott, Cook's Geol. of N. J., 1868, p. 760.—Rhoads, Mam. Pa. and N. J., 1903, p. 18.

Genus PRODELPHINUS Gervais.

Prodelphinus plagiodon (Cope).

Spotted Dolphin.

PLATE 10, FIG. 2.

Length, 7 feet. Very similar in form to the last. Purplish gray above, white below, upper parts spotted with white, lower with dark gray. Teeth, 37 on each side above, 34 below.

There is a skull of this species in the Academy of Natural Sciences of Philadelphia, from off the New Jersey coast, presented by John Krider.

Delphinus clymene Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 201.—Abbott, Cook's Geol. of N. J., 1868, p. 760.

Delphinus plagiodon Rhoads, Mam. Pa. and N. J., 1903, p. 19.

Genus GLOBICEPHALA Lesson.

Globicephala melas (Traill).

Blackfish.

PLATE II.

Length, 15 feet. Forehead vertical, sometimes even overhanging the lips, which protrude slightly, flippers very long (4 feet), dorsal fin situated in front of the middle of the back. Color uniform black, with a V-shaped white mark on the breast connecting with a white stripe down the belly. Teeth, 10 on each side above and below.

These animals are common farther north, New Jersey being the southern limit of their range. From their large size they are popularly classed with the whales and are caught in numbers for their oil.

There is a skull in the Philadelphia Academy collection from Long Beach, N. J.

Globicephala melas Rhoads, Mam. Pa. and N. J., 1903, p. 21.

Globicephala brachyptera Cope.

Southern Blackfish.

Similar in form and size to the preceding, but pectoral fins shorter—not exceeding one-sixth of the total length, and dorsal fin nearer the head—about one-quarter the distance to the tip of the tail. Teeth, 8 on each side above and below.

This is the southern representative of the preceding species, though the ranges of the two may overlap on the northern New Jersey coast.

It was originally described by Prof. E. D. Cope from a specimen caught by fishermen at the mouth of the Maurice river, Cumberland county, N. J., February, 1876.

A skull of the species is also recorded by Prof. Cope from Delaware Bay (Delaware Shore) in 1866.

Globicephalus sp. nov. Cope, Proc. Acad. Nat. Sci., Phila., 1866, p. 7.

Globicephalus brachyptera Cope, Proc. Acad. Nat. Sci. Phila., 1876, p. 129.—Rhoads, Mam. Pa. and N. J., 1903, p. 22.

Genus GRAMPUS Gray.

Grampus griseus (Cuvier).

Grampus, Cowfish.

PLATE 12.

Length, 10 feet. Similar to the Blackfish, with the same high forehead, but recognized by the higher back fin and the absence of teeth in the upper jaw. Color dark gray above, lighter below and on the head, sides with lighter stripes, and flippers black, mottled with gray. Teeth, 6 to 14 on each side in the lower jaw.

According to Dr. True there is a New Jersey specimen of this animal in the National Museum collection, which was stranded at Atlantic City February 2d, 1887, another, he informs Mr. Rhoads, was found on Brigantine Beach March 31st, 1895.

It seems, however, to be a rare species on our coast.

Grampus griseus True, Bull U. S. Nat. Mus., No. 36, 1889, p. 183.—Rhoads, Mam. Pa. and N. J., 1903, p. 21.

Genus PHOCÆNA Cuvier.

Phocæna phocæna (Linnæus).

Harbor Porpoise, Herring Hog.

PLATE 13, FIG. 1.

Length, 5 feet. Head rounded in front, no beak or snout. Fin of the back more triangular than in the Dolphins. Color

dark slate or blackish shading gradually into white on the belly, sides somewhat tinged with pink or yellowish and a dark band from the lower jaw half way to the flipper. Teeth, 26 on each side above and below.

This is the commonest of the round headed or beakless Dolphins and is essentially a coast and harbor species, though it is apparently not as plentiful on this coast as in Europe.

Dr. True records two from Cape May in the U. S. National Museum, and another from New York Harbor.

There is a stuffed specimen in the Museum of the Philadelphia Academy said to have been taken in the Delaware River.

Cassin, Abbott and Rhoads mention this species as ascending the Delaware, Passaic, Raritan and Hudson, but these statements are apparently not based upon actual identified specimens.

Phocæna communis Abbott, Cook's Geol. of N. J., 1868, p. 760.—True, Bull. 36 U. S. Nat. Mus., 1889, p. 118.—Rhoads, Mam. Pa. and N. J., 1903, p. 20.

Delphinus Phocæna Cassin, Hist. Del. Co. Pa., 1862, p. 434.

Genus Orcinus Fitzinger.

Orcinus orca (Linnæus).

Killer.

Plate 13, Fig. 2.

Length, 20 feet. Forehead flat, dorsal fin enormous (6 feet high in the male), flippers short and rounded. Colors black above and white below, in strong contrast; the white extends upward in two stripes on the side, and there is a white spot above each eye and a purplish area behind the dorsal fin. Teeth, 10 to 13 on each side above and below, large and sharp.

These animals are the "wolves of the ocean," to quote Captain Scammon, and pursue, kill and devour "blackfish" porpoises, whales, seals and large fishes. Frequently schools of easy-going porpoises are driven into wild disorder by their approach, and rush madly into the shallows where they are stranded and fall prey to their enemies on the land.

Mr. S. N. Rhoads says that he has seen packs of four to six Killers at Beach Haven and also at Atlantic City, "slowly trailing near the surface with their high dorsal fin standing straight out of the water." (Mammals of Penna. and N. J., p. 23.)

Orca gladiator Abbott, Cook's Geol. of N. J., 1868, p. 760.

Orcinus orca Rhoads, Mam. Penna. and N. J., 1903, p. 23.

Order UNGULATA.

Hoofed Mammals.

To this order belong many of the larger mammals of the world, including almost all of the game animals, and the familiar domestic animals, the horse, cow, sheep, goat and hog.

The Ungulates are characterized by horny hoofs on the toes, corresponding to the claws of the rodents and carnivorous animals. Their legs are usually long, and they are digitigrade, that is to say, they walk on the tips of the toes with the heel considerably elevated so that the main portion of the foot appears like a continuation of the leg, and popularly the hoofed toes alone are regarded as the foot.

In the majority of ungulate animals, moreover, there is a reduction in the number of toes, and the central metatarsal bones, or bones of the "instep," are fused together, the outer ones being much reduced in size and forming the familiar "splints" of the horse's foot.

In the pigs, deer, cows, etc., there are four toes, although two are placed higher up than the others and are smaller in size, while in the horse there is only one toe—the familiar "hoof."

These two groups, the even and odd toed Ungulates, form the two main subdivisions of the order, and are known respectively as the *Artiodactyli* and *Perissodactyli*. The former are also often referred to as split-hoofed ungulates. Many of this group such as the deer, the cow, and their allies have a peculiar four-parted stomach, and they have the habit of casting up the hastily cropped grass into the mouth and chewing it more thoroughly at their

leisure. This process is known as chewing the cud, and the species that have this habit are called Ruminants.

All the Ruminants, and practically all the Ungulates, are herbivorous and have large flat-topped molar teeth, but with the exception of the Pig tribe, the canines are rudimentary or lacking. Many of the Ruminants have horns, sometimes present in both sexes, sometimes only in the males. These are hollow and permanent in the Cattle (*Bovidæ*), and solid, branched and shed annually in the Deer (*Cervidæ*). At the present time there is only one native species of Ungulate animal in New Jersey, namely the Virginia Deer. There is, however, some evidence that both the elk and buffalo at one time occurred in the State, as Dr. C. C. Abbott reported to Mr. Rhoads that bones of both species were found in aboriginal refuse heaps near Trenton, and are now in the Peabody Museum of Archæology, at Cambridge, Massachusetts. Some of the earliest historical accounts of this section also refer casually to buffalo and elk being found here at the time the county was settled, but such evidence is not very reliable.

In the northwestern corner of the State it is probable that elk occurred casually at least within a century, since "a hunter near Delaware Gap, N. J., declared that his grandfather, who killed the last elk in Pike county, Pennsylvania, stated that sometimes the hounds would drive both elk and deer across the Delaware river into the Kittatinny Mountain" (Rhoads, Proc. Acad. Nat. Sci., 1897, p. 25).

Family CERVIDÆ.

Deer and Their Allies.

To this family belong the solid horned Ungulates represented in North America by the deer, elk, moose and caribou. As explained above, the elk is now extinct in the State; while the moose and caribou never occurred so far south.

Genus Odocoileus Rafinesque.

Odocoileus virginianus (Boddert).

Virginia Deer.

Plates 14 and 15.

Length, 6 feet. Height at the shoulder, 3 feet. Length of antler, 20 to 24 inches. Color, bright chestnut in summer with a black band on the chin; throat, under parts and inside of legs, white; tail, brownish above, white beneath. In winter the upper parts are yellowish gray with white about the eye. Antlers curving outward and then upward; there is a short upright spike near the base, beyond which the beam gives off two upright branches making three nearly equal prongs.

The deer is an animal of the forests and open glades, once abundant all over eastern America, it has become nearly or quite exterminated in many sections through the clearing of the country, and the greed of lawless hunters. Tolerance on the part of the hunters and wise protective legislation may re-establish these graceful animals, as has been recently proved in comparatively thickly settled sections of New England.

The deer rut in the autumn, and the fawns, usually two, are born in May or June. They are tawny colored little fellows spotted with white, and lay concealed in the grass or fern beds until the female comes to suckle them. In animals that I have observed in deer parks this takes place after dark. When rutting the bucks have fierce encounters, and sometimes their antlers become firmly interlocked in which position they remain until they succumb to starvation, being unable either to eat or drink. One buck has several does under his protection, and in winter, when the snow is deep, deer associate in small herds and tramp out paths or "yards" in the thickets. They feed at different times of the year on buds, leaves, grass, ferns, small herbs, berries, etc.

The Virginia deer has been separated into two varieties, a northern and southern form, and Mr. Rhoads includes both among the mammals of New Jersey, allotting the southern

variety to the barren pine region of the southern counties and the northern to Sussex and Warren counties in the northwestern corner of the State where it is now practically extinct. As however no adequate series of deer has yet been examined critically from either Pennsylvania or New Jersey, it is impossible to do more than guess at the respective ranges of the two forms, so that we may for the present refer the New Jersey deer to the true *Odocoileus virginianus*. The northern race, *O. v. borealis*, is larger, with heavier antlers and teeth, and with the gray and red pelages of winter and summer more strongly contrasted, while the southern or true *virginianus* is more or less reddish at all seasons. Mr. Rhoads in his exhaustive work on the Mammals of Pennsylvania and New Jersey has compiled a great deal of important information concerning the present and former distribution of deer in southern New Jersey.

They seem to have been finally restricted to Atlantic and upper Cape May counties, with perhaps a few in Burlington, Cumberland and Ocean, and in 1904 it is generally considered that they were nearly extinct. Originally they were abundant all over the State, but as early as 1771 they were decreasing in some sections, and laws were passed making a closed season from January to September, and limiting the size of traps to those used for foxes. In 1832 they were still abundant throughout the pine barrens, according to a writer in Doughty's Cabinet of Natural History.

Mr. Rhoads' informants state that between 20 and 25 were killed in the fall of 1898. From that date until 1903 there has been a closed season, enacted with the hope of replenishing the stock.

In 1904 the southern counties were restocked with deer from elsewhere. At the present time these are increasing so as to become almost troublesome to farmers in the wilder parts of the country. It will now be impossible to secure an unquestionably native deer from this State, and it is doubtful if any specimen is preserved.

Cervus virginianus Beesley, Geol. Cape May Co., 1875, p. 137.—Abbott, Cook's Geol. of N. J., 1868, p. 759.

Odocoileus americana Rhoads, Mam. of Pa. and N. J., 1903, p. 24.

Dorcelaphus virginianus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 25.

Order GLIRES.

Gnawing Mammals.

Here belong our rats, mice, squirrels, rabbits, etc., all of which agree in a remarkable arrangement of the teeth, which at once separates them from all other mammals. The incisors or front teeth, two in each jaw, are curved and grow continuously from the base, as their edges wear away from rubbing against each other during the process of gnawing, which is carried on in precisely the same way whether it be the house mouse making inroads into our cheese, or the beaver cutting down forest trees for his dam.

There are no canine teeth at all in the rodent's jaws and a broad gap extends from the incisors to the flat topped grinders, or molars, set close together, four on each side in the back of the mouth. Rodents are for the most part small animals with short legs and sharp claws on the toes. They are represented by numerous species, widely distributed and adapted for all kinds of life, terrestrial, fossorial, arboreal, ærial and aquatic. The several families to which our New Jersey species belong, may be distinguished as follows:

a. A pair of small rudimentary incisor teeth situated behind the large ones in the upper jaw. LEPORIDÆ (Rabbits.)

aa. No rudimentary incisors.

b. Hair thickly interspersed with sharp spine like quills. ERETHIZONTIDÆ (Porcupines.)

bb. No spines present.

c. Lower leg bones (tibia and fibula) fused together at the lower ends; Mouse Tribe.

d. Hind legs long, tail longer than head and body. ZAPODIDÆ (Jumping Mice.)

dd. Hind legs short, tail not exceeding the head and body. MURIDÆ (Mice and Rats.)

cc. Lower leg bones free. Squirrel Tribe.

e. Tail broad and flat, naked. CASTORIDÆ (Beavers.)

ee. Tail normal, bushy. SCIURIDÆ (Squirrels.)

Family LEPORIDÆ.

Rabbits and Hares.

The chief characteristics of the rabbit family are the elongated hind legs with the resultant jumping gait, the long ears, and the short upturned tail. In cranial structure the peculiarity of the rabbits and hares lies in the presence of two rudimentary incisor teeth back of the large ones in the upper jaw, something that is not found in any other rodent. The true rabbit is the European species, the ancestor of the various domesticated breeds, which is a burrowing animal, and has no counterpart in America. Our species are properly speaking hares which make their nests on the surface of the ground and do not burrow.

We have but one genus of *Leporidæ* in North America, and but three native species in New Jersey. The Belgian Hare, however, has escaped from preserves here and there and may soon have claims as good as those of the house rat and mouse to be included in our fauna.

Genus Lepus Linnæus.

Lepus floridanus mallurus (Thomas).

The Cottontail.

Plate 16.

Length, 17 inches. Color mixed brown, cinnamon and russet, grayer on the rump; ears with dusky edgings and an indistinct dusky spot between them; white below, with a brown band across the breast, lower surface of the tail snow white.

The Common Rabbit, or Cottontail, is one of the most familiar of our native animals; mercilessly hunted by sportsmen of all grades and the prey of rapacious animals, his existence is precarious wherever he may select his home. Except for his inroads

into the truck patches and young orchards, he is a harmless creature; innocent and timid, ever on the alert and almost paralyzed with fear when cornered, he seems to ask our protection, rather than incite us to slaughter. But Br'er Rabbitt" has too long been a table delicacy with certain classes to remove him from the list of game animals, and with such protection, no doubt, he would increase so rapidly as to become a serious nuisance. Even as it is, he seems sufficiently prolific to hold his own, in spite of his numerous enemies.

The nests in which the young rabbits are placed as soon as born are mere hollows in the ground copiously lined and covered with fur from the parent. They are frequently situated in hay or grain fields and are brought to light by the mowing machine, not infrequently with murderous results. The little rabbits are blind at first and remain for some time in their warm nest, visited and suckled by the parent until able to shift for themselves.

Rabbits have regular haunts and travel regularly the same route or path, be it winter or summer, when started from their form or resting place—a habit that not infrequently proves fatal to them, as their paths once learned, the enemy has but to lay in wait till his quarry appears. When bounding away in full flight the underside of the upturned tail forms a conspicuous white spot bobbing up and down, and doubtless of some distinct benefit to the rabbit himself, though attempts to explain just what it is seem to vary.

Lepus sylvaticus Abbott, Cook's Geol. of N. J., 1868, p. 759.—Abbott, A. Naturalist's Rambles, 1885, p. 451.

Lepus nanus Beesley, Geol. Cape May Co., 1857, p. 137.

Lepus floridanus mallurus Rhoads, Mam. Pa. & N. J., 1903, p. 122.

Lepus transitionalis (Bangs).

Northern Cottontail.

Size and general appearance similar to the common cottontail, but more brightly colored with long, black hairs on the back, black borders to the ears and spot between the ears very distinct.

This cottontail occurs all over the northern part of the State and overlaps the range of the other species.

Lepus floridanus transitionalis Rhoads, Mam. Pa. and N. J., 1903, p. 121.

Lepus europæus Pallas.

Belgian Hare.

Length 21 inches. General color grizzly gray, individual hairs gray with black tips, under-fur which shows through more or less, yellowish, face reddish fawn, throat buff, belly white, tail black above, white below.

This large hare has been extensively raised on private grounds and preserves and has escaped to some extent, so that in several parts of the State it is not uncommon to see apparently wild individuals. It is a native of Europe, and can be at once distinguished from the common cottontails by its larger size.

Lepus europæus Rhoads, Mam. Pa. & N. J., 1903, p. 220.

Lepus americanus virginianus (Harlan).

Varying Hare. White Rabbit.

Plate 17.

Length 19 inches. In summer, upper parts russet to dull ferruginous; lower parts white. In winter, entirely white, though some individuals remain partly brown throughout the winter in the southern part of its range.

This is the native hare of the northern evergreen forests, the cottontail being distinctly the animal of the deciduous woods to the south. Where the axeman shows the way the cottontail follows, and as the hemlocks and spruces are cleared away the varying hare retreats into a constantly narrowing range as the other advances.

In Pennsylvania it remains here and there where patches of the boreal forest still stand. In New Jersey, however, it is well nigh exterminated, though a few may still remain in the higher swamps of the Kittatiny range in Sussex and Warren counties.

Mr. Rhoads tells us that they were exterminated in the Greenwood Lake region in 1890, and in 1902 he failed to find them at Culver's Lake and Long Pond.

Lepus americanus virginianus Rhoads, Mam. of Pa. and N. J., 1903, p. 118.

Lepus americanus Rhoads, Proc, Acad. Nat. Sci. Phila., 1897, p. 25.

Family ERETHIZONTIDÆ.

PORCUPINES.

Genus ERETHIZON Cuvier.

Erethizon dorsatus (Linnæus).

Canada Porcupine.

PLATE 18.

Length, 28 inches. Dark brown or nearly black, quills tipped with yellowish, two to four inches long, more or less covered by the hair, which reaches a length of six inches. Toes, four on the front feet and five on the hind.

This curious beast of the north woods, like the varying hare, is being driven back by the advance of the lumberman, and is already a thing of the past in many a spot where it formerly abounded.

The northern mountains of New Jersey were at one time inhabited by porcupines, but the animal is now extinct in the State so far as we know, although Mr. Rhoads thinks it may occasionally cross the Delaware from Pike county in Pennsylvania (Mammals of Penna. and N. J., p. 116).

Erethizon dorsatum Rhoads, Mam. Pa. and N. J., 1903, p. 114.

Family ZAPODIDÆ.

JUMPING MICE.

These curious little mouse-like creatures differ from all of our true mice in the coarseness of their fur and in the immensely long tail and hind legs which adapt them for the wonderful jumping that characterizes them.

Genus Zapus Coues.

Jumping Mice.

Zapus hudsonius Zimmerman.

Meadow Jumping Mouse.

Plates 19 and 20, Fig. 2.

Length, 8.80 inches. Yellowish fawn or rather dark ochraceous, mixed with black tipped hairs, which predominate on the back, making it much darker than the sides; belly white, somewhat suffused with buff; tail, white beneath, brownish above, about 5 inches in length, head and body not quite 4 inches.

This beautiful little animal is not very familiar even to the farmer, and seems to be absolutely harmless, seldom or never devouring any of the crops of the field or garden.

Their home is in the low swamps or meadows, especially among the long yellow *Andropogon* or Indian grass. Here as we pass through we may suddenly flush one of these little animals and he goes bounding up and down clearing the top of grass at every leap and settling again when he thinks he is safe.

Upon the advent of frost they retreat each to his subterranean nest and there curled up in a little round ball pass the strenuous months of winter until the warmth of approaching spring wakens them up again, and they sally forth, to feed and make up for the long winter fast. Mr. E. A. Preble in his Monograph of the Genus Zapus says that they breed from May to September both above and beneath the ground and build summer nests on the ground in thick grass, globular with a side entrance which are occupied by both male and female.

Naturalists have found slight differences in the jumping mice of different sections and two forms inhabit New Jersey. The one just described occurring throughout the northern part of the State, while a slightly different form occurs in the southern counties east and west of the pine barrens, known as the Carolinian Jumping Mouse. *Zapus hudsonius americanus* (Barton). None of these animals have yet been found in the pine barrens.

Jaculus hudsonius Abbott, Cook's Geol. of N. J., 1868, p. 757.

Zapus hudsonius Abbott, A Naturalist's Rambles, 1885, p. 450. —Rhoads, Mam. Pa. and N. J., 1903, p. 109.—Rhoads, Proc. Acad. Nat. Sciences Phila., 1897, p. 28.

Zapus hudsonius americanus Rhoads, Mam. of Pa. and N. J., 1903, p. 110.

Zapus insignis Miller.

Woodland Jumping Mouse.

Plate 20, Fig. 1.

Length 9.80 inches. Larger than the meadow species, less dusky above, sides inclining to rich orange, underparts snowy white, tail with a distinct white tip. Molar teeth only three on each side, while in the other species there are four.

This is a larger edition of the preceding, restricted to the cold boreal forests, though from its small size it can often exist where larger animals have been compelled to retreat owing to the depredations of the woodsmen.

This jumping mouse was only made known to science in 1891 by Mr. G. S. Miller, Jr., who discovered it in New Brunswick. To that indefatigable field naturalist, Samuel N. Rhoads, we are indebted for adding it to the fauna of New Jersey. In May, 1893, he secured four specimens in woods bordering Lake Hopatcong, near Nolan's Point (Proc. Acad. Nat. Sciences Phila., 1897, p. 29). These are now in the collection of the Philadelphia Academy.

The species, doubtless, occurs at other points in the northern tier of counties.

Zapus insignis Rhoads, Mam. Pa. and N. J., 1903, p. 112.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 29.

Family MURIDÆ.

Rats, Mice and Lemmings.

This family of rodents comprises an enormous number of species scattered over nearly every part of the world. They are

usually small animals, generally nocturnal, or living in subterranean runways so that they are seldom seen, although they frequently do an immense amount of damage to crops. They are the natural food of hawks and owls as well as of weasels and other predatory mammals.

The popular terms rat and mouse do not denote natural subdivisions of the family but are simply indicative of size, all the larger species, no matter to what genus they belong, being termed rats, and the smaller species mice. Our native species fall into two sub-families, but like the genera they are separated by characters which are more or less obscure and not by very obvious external differences. However, we can formulate certain differences which hold pretty well for our New Jersey species. Besides these two groups we have several species of the true *Murinæ* of Europe, which have accompanied man wherever he has spread his civilization.

a. Thick set, short legged, short eared, short tailed; tail less than one-third the length of head and body (except the Muskrat). Mainly burrowers
MICROTINÆ (Meadow Mice, Lemmings and Muskrats)

aa. Slender, with longer legs, larger ears and eyes, and long tail more than half the length of head and body, generally much more.
CRICETINÆ (American Long-tailed Mice and Rats)

aaa. Similar to the last but with different skull and teeth, all natives of the Old World. MURINÆ (Introduced Mice and Rats)

Sub-Family MICROTINÆ.

Meadow Mice, Lemmings and Muskrats.

The animals of this group are arranged in several genera which may be distinguished as follows:

a. Tail long and narrow, flattened vertically, nearly naked; animal large, rat-like; total length, 24 inches. FIBER (Muskrat)

aa. Tail very short, slender and hairy; animals small, mouse-like.

b. Upper incisors with a groove (nearer one side than the other).
SYNAPTOMYS (Lemming Mouse)

bb. Upper incisors not grooved.

c. Molar teeth divided at the base into roots, ears slightly visible above the fur. EVOTOMYS (Red-backed Mouse.)

cc. Molar teeth not divided into roots; ears not visible above the fur.
MICROTUS (Meadow Mice)

Genus Synaptomys Baird.

Lemming Mice.

Synaptomys cooperi Baird.

Cooper's Lemming Mouse.

Plate 21, Fig. 2.

Length 4.80 inches. Upper front teeth grooved, tail very short (about three-quarters of an inch). Color sepia brown, mixed with many black hairs, some individuals with a few buff or red-brown hairs, others grayer. Below plumbeous, with whitish tips to the fur, ears very short, overtopped by the hair; mammæ six.

This little mouse is externally the counterpart of the Meadow mouse, with which it associates, but can be distinguished by the grooved incisors and the somewhat shorter tail. It was originally described by Prof. Baird in 1857, and until 1888 no other specimen was obtained east of the Alleghanies, although a few had been found in the Mississippi Valley. In that year and the following, five skulls were discovered in owl pellets and in the stomach of a hawk and an owl. These were from Virginia, Maryland and New York. In August, 1892, Dr. Merriam succeeded in trapping the mice themselves on Roan Mountain, North Carolina, and in a paper reviewing the history of this interesting little animal, he advised those interested in the capture of rare mammals to look out for it in Pennsylvania and New Jersey. Before this paper appeared, however, a specimen was secured by Mr. S. N. Rhoads in a bog near May's Landing, N. J., December 2, 1892. Two others were later secured in the same spot and four more at Tuckahoe and Port Norris. These, so far as I am aware, constitute all the New Jersey specimens except Baird's original example, which is thought to have come from Hoboken, although its exact place of capture is not known. Mr. William Cooper, from whom he received it, lived in Hoboken and hence the inference. In other parts of the country many additional examples have been procured. Mr. Rhoads was under the impression that

the individuals inhabiting the mountains differed slightly from those of the Atlantic plain and named the latter *Synoptomys stonei,* but there seems to be no constant difference between the two.

Coopers' Lemming Mouse is an inhabitant of cold, wet bogs, where it lives in runways through the sphagnum, in company with the meadow mouse, red-backed mouse and long-tailed shrew. It is harder to catch than the other species, which may account for its apparent rarity. We know practically nothing of its habits though it probably feeds on the roots of swamp plants of various sorts.

Synaptomys cooperi Baird, Mammals of N. America, p. 558.

Synaptomys stonei Rhoads, Amer. Naturalist, 1893, p. 53.—Bangs, Proc. Biol. Soc. Wash., 1894, p. 99.

Synaptomys cooperi stonei Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 305 and 392.

Synaptomys stonei Rhoads, Amer. Naturalist, 1893, p. 53.—Bangs, Proc. Biol. Soc. Wash., 1894.

Synaptomys cooperi stonei Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, p. 392, and 1897, p. 305.—Rhoads, Mam. Pa. and N. J., 1903, p. 106.

Synaptomys cooperi Rhoads, Mam. Pa. and N. J., 1903, p. 106.

Genus Evotomys Coues.

Red-Backed Mice.

Evotomys gapperi rhoadsi Stone.

Rhoads' Red-Backed Mouse.

Plate 21, Fig. 1.

Length 5.60 inches. Ears just visible above the fur, color reddish chestnut with numerous black hairs interspersed on the back, sides buffy, below whitish, somewhat suffused with buff, feet light gray, tail brown above, gray below.

I discovered this interesting mouse in a bog near May's Landing, October 25, 1892, securing a specimen in the large runways

which permeate the sphagnum and are the joint highways of several species of mice and the Long-tailed Shrew. Since that time Mr. S. N. Rhoads and I have procured specimens from various parts of the pine barrens, even as far west as the Bear Swamp just east of Medford.

Everywhere it frequents the same sort of locality and is associated with *Synaptomys cooperi,* though it seems far more plentiful.

In the Walkill Valley, near Long Lake, Suffolk County, Mr. Rhoads has obtained the true Red-Backed Mouse of the north *Evotomys gapperi* (Vigors), a slightly brighter, redder animal than the pine barren variety and with less massive teeth (Proc. Acad. Nat. Sciences Phila., 1897, p. 27). It probably occurs elsewhere in the northern tier of counties and intermediate examples may be found in bogs of the intervening country.

(a) *Evotomys gapperi rhoadsi* Stone, Amer. Nat., 1893, p. 55.—Rhoads, Mam. Pa. and N. J., 1903, p. 94.

(b) *Evotomys gapperi* Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 27.—Rhoads, Mam. Pa. and N. J., 1903, p. 92.

Genus Microtus Schrank.

Microtus pennsylvanicus Ord.

Meadow Mouse.

Plates 22 and 24, Fig. 1.

Length 6.50 inches. Body thick, compact; legs short; ears very short. Dark brown above with a general admixture of black hairs, shading gradually into gray on the under surface. The color of the upper part varies considerably, some individuals being decidedly blackish, others tinged with tawny. The under surface varies also to dull buff.

This mouse is very widely distributed from the bogs of the pine barrens to the dry sandy hillsides of the uplands and from the salt meadows, inland to the cornfields of the farmer. While

generally regarded as an injurious species, Mr. S. N. Rhoads, in an able article in the American Naturalist, 1898, p. 571, demonstrates that it has been much maligned. After an exhaustive study, he shows that 90 to 100 per cent. of the food of the meadow mouse is vegetable, 60 to 80 per cent. consisting of grasses, etc., almost exclusively coarse species like rushes, sedges, salt grass (Spartina) and Indian grass (Andropogon), 5 to 10 per cent. roots, and 1 to 5 per cent. grain and seeds. "The arable land," says Mr. Rhoads, "of every well-kept and cultivated farm or nursery, whether in pasture, grass, grain, orchard, truck or young trees, is practically deserted by this mouse. In short, it can only exist where a food supply is found in almost every instance synonymous with neglect and waste on the part of the farmer. It very rarely disturbs seeds, fruits, tubers, roots or vegetables during the growing season, and does little damage in winter to those buried in the ground, most of the ravages in these cases being the work of the pine mouse (*Microtus pinetorum*), and the white-footed mouse (*Peromyscus leucopus*)."

Mr. Rhoads refers to the claims of utility advanced in behalf of the large hawks and owls, on the ground that they destroy so many "injurious" meadow mice, but shows further that such prolific animals as these meadow mice might soon, from sheer overcrowding, be forced to overrun the cultivated grounds and do damage that they do not now think of, should any of the natural checks that Nature places upon their increase be removed. Such occurrences are matters of record in the old world where predacious birds have been destroyed.

The meadow mice are active all the year and on a warm day in winter we may see them passing along their more exposed surface runways with wonderful rapidity or occasionally venturing forth and sitting hunched up into little balls of brown fur, while they nibble some choice morsel.

Arvicola riparia Abbott, Cook's Geol. of N. J., 1868, p. 758.—Abbott, A Naturalist's Rambles, 1885, p. 450.

Microtus pennsylvanicus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 26.—Rhoads, Mam. Pa. and N. J., 1903, p. 97.

Microtus pinetorum scalopsoides (Audubon & Bachman).

Northern Pine Mouse.

Plates 23 and 24, Fig. 2.

Length 6 inches. Uniform rusty brown above, lighter on the sides, silvery gray beneath. Young individuals, gray above with no reddish tint. Fur short, dense and silky like that of a mole. which character distinguishes this species from any other mouse.

All over the lowlands of New Jersey, even up to the slopes of the mountains, this mouse is an abundant species. Unlike the meadow mouse, which makes its runways on the surface, this little animal is strictly subterranean, burrowing like a mole just below the surface. Mr. S. N. Rhoads, who has studied the habits of our wild mice very carefully, is confident that this is the most destructive species, doing much of the damage that is usually attributed to the meadow mouse or the mole. All sorts of roots, tubers and vegetable seeds planted in the garden are favorite food for this animal, and many a planting has to be done over again on account of his depredations. The pine mouse is not restricted to cultivated grounds as it occurs also sparingly in wooded areas.

Our pine mouse is a variety of the pine mouse of the south, originally described by Dr. LeConte, the latter differing in the brighter red, less grayish tone of the fur.

Arvicola pinetorum Abbott, Cook's Geol. of N. J., 1868, p. 758.

Microtus pinetorum Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 26.

Microtus pinetorum scalopsoides Rhoads, Mam. Pa. and N. J., 1903, p. 101.

Genus Fiber Cuvier.

Muskrats.

Fiber zibethicus Linnæus.

Muskrat.

Plate 25.

Length 24 inches. Thick-set like an enormous meadow mouse, legs short, tail compressed laterally, nearly naked and scaly. Fur

thick, with a dense wooly underfur, dark brown somewhat tinged with fulvous, especially on the sides, dull white below, with scattered fulvous hairs; throat and lips white with a brown spot on the chin.

The muskrat is a distinctly aquatic species, abounding in the broad, marshy tracts bordering the larger streams and the bay shores of southern New Jersey. It also occurs along the banks of lakes and far up toward the head-waters of our small streams, as well as along the canals. By digging its burrows through the banks of the latter and through the dykes that are constructed here and there to protect meadows or to drain up the cranberry bogs, it does serious damage. In fact, this is about the only way in which the muskrat becomes an enemy to mankind. His food consists of various acquatic plants and roots which are of no especial value.

The true home of the muskrat is a burrow in a bank, the mouth usually under water but the terminal nesting chamber clear above the water line. Here the little ones are born. In the larger bodies of water or in extensive marshes they build the large dome-shaped lodges which are so conspicuous, standing up in winter clear above the dead and flattened marsh grass like so many old fashioned ovens. These are built of sods and tufts of grass and rushes, and are usually very hard and almost impenetrable to ordinary enemies on the outside; inside is a chamber high up above the water line, lined with grass; below, passageways pass out through the water in several directions. The fur of the muskrat has always been a regular source of gain for the trapper and immense numbers of their pelts are sold annually in this State. Originally used only for caps, robes, etc., they are now prepared and dyed and constitute much of the commercial furs that are sold under the more alluring names.

Fiber zibethicus Abbott, Cook's Geol. of N. J., 1868, p. 758.—Abbott, A Naturalist's Rambles, 1885, p. 451.—Beesley, Geol. Cape May Co., 1857, p. 137.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 27.—Rhoads, Mam. Pa. and N. J., 1905, p. 104.

Sub-Family CRICETINÆ.

American Long-Tailed Mice and Rats.

The New Jersey species fall into three genera.

a. Size large, rat-like; molars flat on top, divided into triangles. NEOTOMA (Wood Rats)

aa. Size medium, rat-like; molars tuberculate; strongly resembling a young Norway Rat. ORYZOMYS (Ricefield Mouse)

aaa. Size small, mouse-like. PEROMYSCUS (Deer Mice)

Genus Neotoma Say and Ord.

Wood Rats.

Neotoma pennsylvanica Stone.

Alleghany Wood Rat.

Plate 26, Fig. 2.

Length 16.40 inches. Tail nearly as long as the body, ears prominent. Color plumbeous gray above, sprinkled with black hairs and with a yellowish-brown under-tone, becoming brighter and almost pink on the flanks. Feet gray above, white below, closely haired so as to obscure the scales.

While wood rats had once or twice been reported from the Middle States, it was supposed that they had been brought from the south, where they abound, and had escaped. In 1892, however, Mr. J. G. Dillen procured some specimens from Cumberland County, Pennsylvania, which he submitted to me for examination, and I at once saw that they were of a different species from the southern wood rat (*Neotoma floridana*). Since then the species has been detected in rocky locations on the hills and mountains from the Hudson Highlands southward through the Alleghanies. In New Jersey the wood rats have been found only on Greenwood Mountain, near the lake of that name, in Passaic County, where Mr. Rhoads trapped several specimens in 1896 (Proc. Acad. Nat. Sciences Phila., 1897, p. 28). It probably occurs elsewhere in the mountains.

This rat lives in caves, crevices, and rock piles. They feed on various nuts and other vegetable matter and gnaw at bones that remain from the feasts of such carnivorous animals as may share their rocky retreats. They sometimes build large bulky nests, formed by heaping up leaves, grass and various vegetable fibres.

This rat can always be told from the domestic or Norway rat by the hairiness of the tail, softer fur and much larger ears, while the molar teeth are flat-topped, not raised into "tubercles." The wood rat, too, lacks the disagreeable odor of the other species, and is altogether a cleaner, brighter-colored animal.

Neotoma magister Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 28.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1894, p. 219.

Neotoma pennsylvanica Rhoads, Mam. Pa. and N. J., 1903, p. 85.

Genus Oryzomys Baird.

Ricefield Mice.

Oryzomys palustris (Harlan).

Ricefield Mouse.

Plate 27.

Length 9.40 inches. In general appearance very much like a young Norway rat. Dull brown, thickly mixed with black hairs. Tail obscurely bicolored, scantily haired. Best distinguished from the young Norway rat by the larger tail, browner color, and the white fringe of hairs on the lower part of the ear and glossy brown hairs inside. It also has orange front teeth which are white in the young rat and the tubercles on the molar teeth form two rows instead of three.

This mouse, common through the south, was supposed to have originally come from New Jersey, Dr. Harlan stating that his type specimen came from Salem. All efforts on the part of Mr. Rhoads, myself and others, however, failed to rediscover it and the impression was gaining ground that there was some error regarding the locality of Dr. Harlan's specimen, when Mr. Henry

W. Warrington obtained two specimens in a muskrat house not far from Salem, November 21, 1898, sixty-two years after the original one was taken. Subsequently Mr. Rhoads secured specimens from muskrat houses on Cohansey Creek and at Greenwich, and no doubt the mouse is found in similar localities all along the tide water streams and marshes of southern New Jersey.

Mus palustris Harlan, Silliman's Am. Jour. Sci. and Arts, 1837, p. 386.

Oryzomys palustris Stone, Proc. Acad. Nat. Sci. Phil., 1898, p. 480.—Rhoads, Mam. Pa. and N. J., 1903, p. 81.

Genus Peromyscus Gloger.

Deer Mice.

Peromyscus leucopus (Rafinesque).

White-Footed Mouse.

Plates 28 and 29, Fig. 2.

Length 6.80 inches. Brownish fawn-color above, brighest on the sides and darkest on the back where there is a considerable sprinkling of black hairs; white below, fur plumbeous at its base, tail dusky above, light beneath, feet white. Young plumbeous gray, white below.

This is our most abundant native long-tailed mouse, found about fence rows, in woods and thickets and under the overhanging banks of streams. It is a beautiful and harmless little animal living upon all sorts of seeds, roots, nuts and such grain as it finds scattered about. It forms granaries or store houses in hollows, in trees and similar receptacles and builds its nest in all sorts of places sometimes making use of an old bird's nest ten feet above the ground, this is covered over and thus protected serves the mouse's purpose admirably.

These mice are mainly nocturnal and their tracks in the freshly fallen snow testify to their activity and abundance. In camps and similar buildings out in the woods the white-footed

mice frequently take up their abode and make free with whatever nest materials they may find. Sometimes, too, they are caught in the farm house in winter.

The white-footed mouse is the most frequent species caught in the mammalogist's traps and so abundant are they in some places that it seems as if they have to be exterminated before any other species has an opportunity to test the qualities of the trap. They prove a nuisance also in chewing the eyes, ears and other parts of specimens caughts in traps before they can be gathered up. Even individuals of their own species are devoured by these canabalistic little animals, not only dead ones in a trap but captive live ones that have been killed in conflict with their fellow prisoners.

The attempt has been made to divide this species into a northern and southern race, but the distinctions of color upon which the difference rests are so fine that they defy my powers of observation at least so far as New Jersey specimens are concerned. Those who care to call the animal of the northern counties *P. leucopus noveboracensis* (Fischer), however, are free to do so, and should find it duller above and tinged with gray beneath.

Hesperomys leucopus Abbott, Cook's Geol. of N. J., 1868, p. 758.—Abbott, A Naturalist's Rambles, 1885, p. 450.

Peromyscus leucopus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 27.—Rhoads, Mam. Pa. and N. J., 1903, p. 80.

Peromyscus leucopus noveboracensis Rhoads, Mam. Pa. and N. J., 1903, p. 81.

Sub-Family MURINÆ.

Old World Mice and Rats.

Mus musculus Linnæus.

House Mouse.

Plates 30 and 29, Fig. 1.

Length 6.70 inches. General color gray slightly tinted with yellowish brown, especially on the face and shoulders, dusky on the back, below paler gray sometimes buffy.

Too well known about houses, but often trapped, in summer at least, at long distances from houses, though in open farming districts.

Mus musculus Abbott, Cook's Geol. of N. J., 1868, p. 758.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 28.—Rhoads, Mam. Pa. and N. J., 1903, p. 218.

Mus norvegicus Erxlebon.

Norway Rat.

PLATES 31 AND 26, FIG. 1.

Length 18 inches. Heavily built, head thick, ears moderate, tail medium, shorter than head and body. Color yellowish brown, thickly interspersed with long black hairs, grayish white below. Tail very sparsely haired with the scales very conspicuous, ears dull brown. Young dull gray with no brown tints.

Abundant everywhere about the habitations of man and sometimes at some distance from them. The old ones slightly resemble the wood rat, while the half-grown young closely resemble the rice-field mouse. The distinctions are pointed out under these species.

The Norway rat seems to have everywhere exterminated or crowded out the black rat, *Mus rattus*, which was the first emigrant rat to establish itself in many places. I know of no surviving colonies in the State.

Mus decumanus Abbott, Cook's Geol. of N. J., 1868, p. 758.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 28.—Rhoads, Mam. Pa. and N. J., 1903, p. 218.

Family CASTORIDÆ.

THE BEAVERS.

These curious animals are the largest North American rodents. They are thoroughly acquatic with a curious broad, flat tail and webbed feet.

In the structure of their legs they belong nearer to the squirrels than to the mouse tribe, having the bones of the lower legs separate and not fused together.

Family CASTORIDÆ.

Beavers.

One species found in Europe and one in America the latter divisible into several races.

Genus Castor Linnæus.

Beaver.

Castor canadensis carolinensis Rhoads.

Southeastern Beaver.

Plate 32.

Length 44 inches. Tail broad, flat and naked; second toe of the hind foot with two claws. Body thick and heavy, closely furred, dark bay or blackish brown, hairs tipped with chestnut, ears black, feet, legs and underparts seal brown.

The beaver that originally occurred in New Jersey was the southern or Carolina Beaver somewhat lighter and larger than the Northern or Canadian form. It is now nearly extinct everywhere, and according to the information collected by Mr. Rhoads, the last New Jersey specimens were killed about 1820. All that we have left of the native beaver are traces of dams in various streams of south Jersey. One very large one that I have visited is located on Nescochaque branch of the Mullica river and is now a great stretch of grassy land interspersed with bogs. The original damming and flooding killed off the trees and they have never grown again.

Beavers were in the habit of building large lodges somewhat like those of the muskrats, but unlike the muskrats they also constructed great dams which backed up the water and made the necessary lakes or ponds for the building of the lodges. In the construction of these dams great trees were cut down, gnawed through near the base by the tireless animals and cut up into lengths, the whole colony working at the undertaking. In August,

1900, Mr. J. von Lingerke described the presence of a colony of beavers in Sussex County, which had apparently escaped from a private preserve where they had been introduced. At any rate they were firmly established at that time.

Castor canadensis Abbott, Cook's Geol. N. J., 1868, p. 757.—von Lingerke, Forest and Stream, 1900.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 29.

Castor canadensis carolinensis Rhoads, Mam. Pa. and N. J., 1903, p. 73.

Family SCIURIDÆ.

Squirrels and Marmots.

This family comprises animals which are on the average larger than the *Muridæ*, very active and intelligent and usually handsome, with graceful, more or less bushy tails. Some species are fossorial, while others are arboreal, and one, the flying squirrel, is not only arboreal but aerial, curious "parachutes" being developed between the legs. The several genera found in New Jersey may be separated as follows:

a. Body large. MARMOTTA (Ground Hogs)
aa. Body less than fifteen inches in length.
b. No extensible flying membrane on the sides of the body.
c. Tail short, only one-third to one-half the length of head and body.
d. Color uniform gray. CITELLUS (Spermophiles)
dd. Back striped. TAMIAS (Chipmunk)
cc. Tail long and bushy. SCIURUS (Squirrels)
bb. An extensible fold of skin on the sides of the body for flying. SCIUROPTERUS (Flying Squirrel)

Genus Marmotta Zimmerman.

Woodchucks.

Marmotta monax (Linnæus).

Woodchuck, Groundhog.

Plate 33.

Length 24 inches. Heavy and thick-set, legs short, tail rather short and bushy. Color grizzly or yellowish gray varied with black and rusty, under parts rusty, feet black.

This is a common species in the northern counties of the State, i. e., north of Mercer and Middlesex, though often local. In these counties, according to Mr. Rhoads, it is not common, and southward it is very rare or casual. Mr. Rhoads mentions occurrences of single individuals at Medford, Mt. Laurel, Haddonfield, Ashland, Greenwich, Tuckerton, Egg Harbor and Salem, and only six of these later than 1890. Mr. H. Walker Hand writes me that he still hears of one taken now and then in the Cedar Swamps of Upper Cape May County. A significant point about all these south Jersey records is that they lie around the Pine Barrens, either or west of this region, but not in it. The excessively sandy character of south Jersey is perhaps not suitable to this species, at any rate it is far more at home in the hilly country and on the slopes of the Kittatiny Mountains.

The groundhog is a familiar feature of an upland farm, the large holes leading to its subterranean retreat, and the pile of earth beside them are to be seen here and there over the meadows, or along the fence rows, and occasionally even in woodland. Frequently, too, the groundhog may be seen nearby standing upright on his hind legs in true Marmot fashion, and then as you approach he is down on all fours and scuttling for his burrow as hard as he can go. He comes out to feed early in the morning or late in the afternoon, cropping the grass and herbs and nibbling at apples and other fruit that lie scatered on the ground. He often climbs up on an old rail fence and lies there basking in the sun, and on rare occasions I have seen them in small trees some eight or ten feet from the ground, but what the object of such a climb might be I failed to discover. The main objects in life of the groundhog seem to be eating and digging, and in neither respect does he benefit the farmer upon whose land he may take up his abode.

Unlike the muskrat his hide is coarse and of no value.

Aoctomys monax Abbott, Cook's Geol. of N. J., 1868, p. 757.—Abbott, A Naturalist's Rambles, 1885, p. 450.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 29.—Rhoads, Mam. Pa. and N. J., 1903, p. 63.

Genus Citellus Oken.

Spermophiles.

These are squirrel-like animals living on the ground or in the burrows which they construct. They abound in the western States, east to the Mississippi Valley.

Citellus franklini (Sabine).

Franklin's Spermophile.

Plate 34.

Length 14.80 inches. Hair coarse and harsh; gray above, suffused with yellowish brown individual hairs banded with black, below paler; throat white; tail pure gray.

This little animal was introduced at Tuckerton in May, 1867. A pair that had been brought from Illinois by Mr. Sylvester Mathis escaped from their cage and established themselves in the sandy fields (Coues and Allen Monographs of N. A. Rodentis, 1877, p. 883). Since then they have spread as far north as Manahawken and west to Speedwell, and though they are not common they still persist and in some places do quite a little damage to crops. Mr. Joseph E. Sapp shot one on his property in Tuckerton, May 10, 1907, which is now in the collection of the Philadelphia Academy. The spermophiles have much the habits of the groundhog and the prairie dog, standing upright to watch the surrounding country and diving into their burrows on the approach of danger. Some burrows are probably for shelter only, others communicate with the nest and with chambers where grain and other food is stored. In winter these animals hibernate like the groundhog and chipmunk.

Spermophilus franklini Allen, Mongr. Rodentia, 1877, p. 883.
Citellus franklini Rhoads, Mam. Pa. and N. J., 1903, p. 221.

Genus Tamias Illiger.

Chipmunks.

Fossorial squirrels intermediate between the true squirrels and the spermophiles though more closely related to the latter.

Tamias striatus (Linnæus).

Chipmunk, Striped Squirrel, Groundhackee.

Plate 35.

Length 9.50 inches. Head brown, back grizzled gray, rump and hind legs rufous chestnut, a narrow black stripe down the middle of the back from the ears to the rump, and on each side a light buff stripe bordered with black, sides of body buffy, below white. Tail grizzly gray above with black tips to the hairs, below rufous edged with black.

This is the most familiar and most confiding of our smaller mammals, its diurnal habits making it easy to see while it lingers close to man's habitations as long as suitable surroundings are to be found. The chipmunk is a harmless little animal, doing little or no damage to crops or gardens and living on wild nuts, berries, roots and occasionally insects of various sorts. In fall they are especially noticeable in the vicinity of nut trees and may be seen scampering away with their cheeks stuffed with nuts which are hidden away in their storehouses for later use. The burrows of the chipmunk are inconspicuous from the fact that we rarely find any earth about the openings such as mark the entrances to the woodchucks' galleries. Apparently all the exhumed earth is carefully carried away and deposited at some distance from the operation. In the depth of winter the chipmunks hibernate in their nests underground, but they are not so completely torpid as some other species and are occasionally to be seen even in mid-winter. When alarmed a chipmunk will bolt for his burrow and shoot into it uttering a shrill cry as he goes down, often returning im-

mediately to the entrance to call again in derision, as it were, or more likely as a warning to his companions.

Mr. Rhoads states (Mammals of Penna. and N. J., p. 62), that although the young are usually supposed to be born in the spring he has obtained young, two-thirds grown, in October.

Sciurus striatus Beesley, Geol. Cape May Co., 1857, p. 137.

Tamias striatus Abbott, Cook's Geol. N. J., 1868, p. 757.—Abbott, A Naturalist's Rambles, 1885, p. 450.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 30.—Rhoads, Mam. Pa. and N. J., 1903, p. 61.

Genus SCIURUS Linnæus.

Sciurus rufiventer neglectus (Gray).

Fox Squirrel.

Length 23.50 inches. Large, with very long bushy tail. Grizzly or yellowish gray, hairs banded with black; more or less rusty tinted above; under parts pale ferrunginous to nearly white, tail rusty beneath, bordered with black. Color distribution variable.

Now quite extinct in New Jersey, though once distributed over practically the whole State. Elsewhere its history is the same and it is to-day only found at a few points south. The very large size of this squirrel would distinguish it from any other species.

Sciurus cinerens Abbott, Cook's Geol. of N. J., 1868, p. 756.

Sciurus vulpinus Beesley, Geol. Cape May Co., 1857, p. 137.

Sciurus rufiventer neglectus Rhoads, Mam. Pa. and N. J., 1905, p. 58.

Sciurus carolinensis (Gmelin).

Gray Squirrel, Black Squirrel.

PLATE 36.

Length 18 inches. Large bushy tail like the fox squirrel, but much smaller. Color yellowish gray, hairs banded with rusty yellow and black; face, feet and sides quite rusty, belly white.

Hair of the tail rusty gray at the base, black in the middle and white at the tips.

This squirrel is a familiar feature of public parks and private grounds in many of our towns and cities, where, afforded proper protection, it becomes so tame as to feed out of one's hand. In southern New Jersey as in other parts of its range, it has become scarce or local, owing no doubt in some degree to the fact that it is everywhere regarded as a game animal, and squirrel hunters are out in force in November in every wood that harbors these beautiful animals. Gray squirrels make their nest in a hollow tree or similar shelter, and carry in leaves and soft materials for lining. Here the young are reared. Sometimes they build the nest wholly of leaves among the branches of a tree top. They live on nuts, fruit and berries of different sorts and are not at all averse to robbing birds' nests. When pursued they fairly fly from tree to tree running out on the slender branches and leaping to the limbs of an adjoining tree, or when cut off and fairly cornered they will ascend the main trunk and hang close to the bark, flattening out the body so as to easily escape detection.

The gray squirrels of the Pennsylvania mountains and northward are larger and clearer gray, constituting a distinct race, the northern gray squirrel (*Sciurus carolinensis leucotis*), which merges gradually into the southern form. Mr. Rhoads is of the opinion that the gray squirrels of the mountains of northern New Jersey belong rather to this race rather than true *carolinensis,* at any rate they have a tendency that way.

Among gray squirrels, more especially the northern form, we find a certain number of black ones, simply melanistic individuals and differing no more from the grays than the occasional albino animals differ from the normally colored examples. Both blacks and grays occur in the same nest and pair promiscuously (Rhoads, Mammals of Penna and N. J., p. 56).

So far as I am aware no gray squirrels occur in the pine barrens, this species being distinctly an animal of deciduous woodland probably never did occur in that region.

(a) *Sciurus carolinensis* Abbott, Cook's Geol. of N. J., 1868, p. 756.—Abbott, A Naturalist's Rambles, 1885, p. 450.—Rhoads, Mam. Pa. and N. J., 1903, p. 52.

Sciurus leucotis Beesley, Geol. Cape May Co., 1857, p. 137.

(b) *Sciurus carolinensis leucotis* Rhoads, Mam. Pa. and N. J., 1903, p. 52.

Sciurus carolinensis pennsylvanicus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 30.

Sciurus niger Abbott, Cook's Geol. of N. J., 1868, p. 756.

Sciurus migratorius Abbott, Cook's Geol. of N. J., 1868, p. 756.

Sciurus hudsonicus loquax Bangs.

Chickaree, Southern Red Squirrel.

PLATE 37.

Length 12 inches. Color in winter bright chestnut on the back and upper side of tail; sides olive gray, hair banded with black; below white. In summer, no distinct rufous area above, and lower parts pure white with a black stripe on each side where the two colors join.

This is the commonest of our aboreal squirrels, frequenting all kinds of country. In the depth of the pine woods of the "Barrens" he may be heard chattering away, and careful search will discover his nest snugly placed in a dense pine top, built of leaves, lichens and shreds of bark. Below is an enormous pile of chewed pine cones from which he has carefully extracted the seeds.

In deciduous woods he selects a hollow in some large tree, and in lieu of pine cones we find a bushel or more of the winged tops of the seeds of the tulip poplar, or walnuts and hickory nuts neatly cut on each side where the kernels have been extracted.

About the orchard the red squirrel is a good deal of a nuisance, chewing up quantities of small pears in order to get at the seeds and stealing grain or anything in fact that he may find accessible.

When we see the red squirrel racing along the fence rails and up the tree trunks and then from limb to limb we can readily see the line of evolution followed in the development of the flying squirrel. With legs outstretched, leaping considerable distances through the air, it needs but little imagination to see the expanded skin on the sides of the body which aids the latter in his parachute flight.

The true Hudson Bay red squirrel (*Sciurus hudsonicus*), is restricted to the far north, from Labrador and Hudson Bay to Alaska. From Maine and Canada south through the Alleghanies occurs variety *S. h. gymnicus,* the southern red squirrel, and on the Atlantic slope to Virginia the southern form *S. h. loquax*. All the New Jersey examples seem to belong to the last though some of those of the extreme northwest may tend toward the duller grayer, *gymnicus,* which, in the winter, has the lower surface tinged with gray.

Sciurus hudsonicus Abbott, Cook's Geol. of N. J., 1868, p. 756.—Abbott, A Naturalist's Rambles, 1885, p. 450.—Beesley, Geol. of Cape May Co., 1857, p. 137.

Sciurus hudsonicus loquax Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 30.—Rhoads, Mam. Pa. and N. J., 1903, p. 57.

Genus Sciuropterus F. Cuvier.

Flying Squirrels.

Sciuropterus volans (Linnæus).

Southern Flying Squirrel.

Plate 38.

Length 9.40 inches. Fur soft and dense like that of a mole. Drab above irregularly tinged with russet, slightly brighter in summer, under parts pure white.

During the daytime some hollow tree or some crevice or cranny under the eaves of an old house shelters the flying squirrels, and only at dusk do we see them come forth; running up the trunk of a tree and launching forth with legs extended, they sail gracefully downward to alight on another trunk and again begin the ascent.

Large numbers usually occupy the same hollow tree, and by rapping upon it they may often be driven out even though it be daytime.

Flying squirrels seem to be pretty well distributed over the State, though I am not sure of their occurrence in the heart of

the pine barrens. To the northward a larger species of flying squirrel occurs, but so far it has not been detected within the State limits.

Pteromys volucella Abbott,—Cook's Geol. of N. J., 1868, p. 757.—Beesley Geol. Cape May Co., 1857, p. 137.

Sciuropterus volucella Abbott, A Naturalist's Rambles, 1885, p. 449.

Sciuropterus volans Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.—Rhoads, Mam. Pa. and N. J., 1903, p. 66.

Order INSECTIVORA.

Moles and Shrews.

These little animals are mouse-like in appearance, but with a full set of sharp teeth, recalling those of the carnivorous animals. They live for the most part in burrows and runways and their eyes are very small or rudimentary. We have two families.

a. Fore feet similar to the hind ones, and not modified for digging; snout long and pointed; scarcely a trace of an external ear; eyes very small. SORICIDÆ (Shrews)

aa. Fore feet very broad and turned on edge, specially adapted for digging; no external ear whatever; eyes rudimentary. TALPIDÆ (Moles)

Family SORICIDÆ.

Shrews.

These little animals have the same soft, velvety fur as the moles, but differ in not having the fore-feet modified for digging. We have two genera in New Jersey.

a. Tail quite long, snout long and very slender. SOREX (Shrews)

aa. Tail short, snout short. BLARINA (Short-tailed Shrews)

Genus Sorex Linnæus.

True Shrews.

Sorex personatus Geoffroy.

Long-Tailed Shrew.

Plate 39, Fig. 3.

Length 3.75 inches. Small and slender, with a long pointed snout supporting long whiskers. Tail nearly as long as the head and body. Dark brown above, hair slaty at the base, brighter on the rump, shading to gray below.

This is the smallest mammal found in the State of New Jersey and it is very rarely that we are favored with a sight of it. My own experience is entirely confined to trapping them and I have never seen a live individual. They are most abundant along the edge of the salt marshes, just where they join the upland, and are also found in the bogs of the pine barrens. In the northern parts of the State, according to Mr. Rhoads, they are frequent. The long-tailed shrews seem to occupy the same runways as the meadow mice, and also venture forth among the leaves on the floor of the woods in search of insects, worms, etc., which constitute their food.

On the ocean side of the State I have found them abundant as far south as Cape May, but in west Jersey I know of only one record, a specimen secured by Mr. Rhoads at Haddonfield.

Sorex forsteri Abbott, Cook's Geol. of N. J., 1868, p. 752.

Sorex personatus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 33.—Rhoads, Mam. of Pa. and N. J., 1903, p. 189.

Sorex fumeus Miller.

Smoky Shrew.

Length 4.50 inches. Slightly larger than *S. personatus,* dark slate color above shading into lighter ash below; browner in summer. The second and third unicuspid teeth (small single teeth

lying in front of the large molars) are twice as large as the fourth and fifth while in *personatus* their size decreases gradually.

This is a mountain species rarer than *personatus* and known as a New Jersey species only from two specimens obtained by Mr. S. N. Rhoads at Greenwood Lake, Passaic county, and at Culver's Gap, Sussex county.

Its habits are doubtless the same as those of the last.

Sorex fumeus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 33.—Rhoads Mam. Pa. and N. J., 1903, p. 190.

Genus Blarina Gray.

Short-Tailed Shrews.

Blarina brevicauda (Say).

Short-Tailed Shrew.

Plate 39, Fig. 2.

Length 5 inches. Rather stout, tail only about one-quarter the length of the head and body. Sooty plumbeous, slightly lighter below, front teeth chestnut colored at the tips.

This little animal, popularly regarded as a mouse though at once separated by the velvety, silver gray, mole-like fur, is abundant throughout the State in woods, edges of stream and bogs, etc. It lives in burrows, and like all the shrew tribe is seldom to be seen. It is carnivorous in the main, eating insects, snails, and, in captivity at least, other individuals of its own species as well as meadow mice larger than itself. On all counts it would seem to be a distinctly useful litle animal and well worthy of protection.

Blarina talpoides Abbott, Cook's Geol. of N. J., 1868, p. 752.

Blarina brevicauda Abbott, A Naturalist's Rambles, 1885, p. 449.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 32.—Rhoads Mam. of Pa. and N. J., 1903, p. 192.

Blarina parva (Say).

Brown Shrew.

PLATE 39, FIG. 1.

Length 3.75 inches. Dark brown or iron gray above, ashy below.

This little animal differs from the short-tailed shrew only in size and color. It seems to be rather scarce wherever found, but this may be due to ignorance of its favorite haunts. I have secured it near Cape May, and Mr. Rhoads records it from Tuckerton, Hackensack marshes, Princeton and Berkeley Heights, Union county.

Blarina parva Miller. Bull. N. Y. State Museum, 1899, p. 362. —Rhoads, Mam. Pa. and N. J., 1903, p. 196.

Family TALPIDÆ.

MOLES.

These curious animals are adapted for a life underground. Their fore-feet are curiously modified into large hands standing on edge, while the arms are greatly reduced. The muscular power of the fore-feet is very great and the animal can dig its way with tremendous rapidity, usually forcing the earth up at the surface.

We have several different moles belonging to three genera.

a. A fleshy star on the nose, teeth i 3/3, c 1/1, p 4/4, m 3/3.*
CONDYLURA (Star-nosed Mole)

aa. No fleshy star.

b. Tail naked, teeth i 3/2, c 1/0, p 3/3, m 3/3.
SCALOPS (Naked-tailed Mole)

bb. Tail hairy, teeth i 3/3, c 1/1, p 4/4, m 3/3.
PARASCALOPS (Brewer's Mole)

*i—incisors, c—canines p—premolars m—molars, 3/3—three above and three below.

Genus Scalops Illiger.

Naked-Tailed Moles.

Scalops aquaticus (Linnæus).

Common Naked-Tailed Mole.

Plate 40, Fig. 1.

Length 6.40 inches. Hands large and naked with powerful claws, hind feet small and of normal shape, snout long and pointed, tail short and naked. Color glossy silvery gray, often tinged with rusty.

This curious animal spends its entire life in the ground burrowing here and there at varying depths in pursuit of the earthworms which constitute its chief article of food. The operations of the mole are much more frequently seen than the animal himself, not only the ridges of raised sod, which mark his tunnelings just beneath the surface, but the piles of loose earth which he forces out from diggings farther under ground.

The nest or true home of the mole, according to Godman, is a cavity six by three inches, some eight inches from the surface, in hard soil with numerous communicating passages.

Moles travel with wonderful rapidity along their passageways, and it is no easy matter to capture one whose presence may be detected from the moving soil at the surface. He usually backs away and is gone before we have the burrow opened. The tunnels are promptly repaired as often as they are broken in, and traps or pitfalls constructed in them are carefully covered with earth or a new tunnel dug around them. Mr. Harry Wilson* and Mr. S. N. Rhoads** have discussed the economic value of moles.

The outcome of their investigations seem to be (1) that the mole's food is wholly animal matter, mainly earth worms, the remainder being largely composed of injurious insects, (2) that the mole constructs numerous runways very often undermining

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* *Bull. 31 Penna Dept. Agriculture, 1898.*

** *Forest and Stream, March 5, 1898.*

plants or vegetables and opening up passages where pine mice and other injurious mammals may follow.

Mr. Wilson concludes solely on the basis of food that the mole is beneficial to the farmer, but Mr. Rhoads points out that it is unfair to class the earthworm as injurious since it has been shown to be a most important factor in increasing the arable quality of soil. And as the destroyer of countless earthworms we can make out a strong case against the mole, irrespective of the damage directly or indirectly due to his surface tunnels. On his behalf, however, we can urge the benefit of his burrows in improving the soil on somewhat the same ground as those of the earthworm.

The naked-tailed mole occurs throughout the State, but is most plentiful in open, cultivated country. It seems to be rare in the sandy pine barrens, though Mr. Rhoads states that he has seen its burrows there also.

Scalops aquaticus Abbott, Cook's Geol. of N. J., 1868, p. 752. —Abbott, A Naturalist's Rambles, 1885, p. 448.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1867, p. 32.—Rhoads, Mam. Pa. and N. J., 1903, p. 198.

Genus Parascalops True.

Hairy-Tailed Moles.

Parascalops breweri (Bachman).

Brewer's Mole.

Plate 40, Fig. 2.

Length 5.80 inches. Dark gray, tail blackish and thickly haired, rather longer than that of the preceding species, nose and hands similar. This is a northern species occurring southward through the Alleghanies. There is only one record of its occurrence in the State—a specimen in the collection of the Philadelphia Academy, labeled "New Jersey, Edward Harris." It will, no doubt, be found to occur in the mountains of Sussex, Warren and Passaic counties.

Scalops breweri Abbott, Cook's Geol. of N. J., 1868, p. 752.
Scapanus breweri Abbott, A Naturalist's Rambles, 1885, p. 449.
Parascalops breweri Rhoads, Mam. Pa. and N. J., 1903, p. 204.

Genus CONDYLURA Illiger.

Star-Nosed Moles.

PLATE 41.

Condylura cristata (Linnæus).

Star-nosed Mole.

Length 6.80 inches. Hand similar to scalops, but weaker. Color dark gray, with a brown tinge, paler beneath, tail long and hairy, sometimes very thick at the base. Snout with a remarkable naked appendage resembling a many-pointed star.

This mole is more acquatic than the naked-tailed species, and frequents meadows and the immediate vicinity of streams. Floods do not seem to trouble it in the least, and it no doubt frequently takes to the water of its own accord, as it has been seen swimming by careful observers.

This mole is very abundant in the northern half of the State, but does not, so far as I am aware, occur in the pine barrens. In southwestern New Jersey and along the coast strip to the east it occurs rarely.

Condylura cristata Abbott, Cook's Geol. of N. J., 1868, p. 752.—Abbott, A Naturalist's Rambles, 1885, p. 449.—Rhoads, Proc. Acad. of Nat. Sci. Phila., 1897, p. 32.—Rhoads, Mam. Pa. and N. J., 1903, p. 206.

Order CHIROPTERA.

Bats.

Bats are the mammals of the air, being peculiarly modified for flight, while they are unable to progress on the ground, except by awkward leaps, or by flapping of the wings.

The "wings" consist of immensely elongated fingers, between which is a delicate Indiarubber-like membrane, which extends down along the sides of the body to the hind feet, and also out to the tip of the tail. The toes on the hind feet are not elongated, and they, as well as the short-clawed thumb of the hand, are used in grasping limbs, or other support, when they come to rest, or wish to hang themselves up.

Bats fly about at dusk and just before dawn and, to some extent, throughout the night, and feed on insects of various sorts which they catch on the wing. They may often be seen about electric arc-lights, where such vast hosts of insects are assembled every night during the summer, and where they must be able to make an ample meal. During the day they hang in trees concealed among the leaves, or congregate in dark garrets, under the eaves of buildings, or in caves, or similar places of refuge. Their teeth are somewhat like those of the shrews—small and sharp, and their eyes are quite small. They utter an extremely shrill, grating squeak when caught and irritated. Bats are strictly beneficial to man, and in spite of the numerous stories and superstitions connected with them, they are absolutely harmless, and should be welcomed about our houses, rather than driven away. Their repellant appearance and unpleasant musky odor will, however, always make them undesirable visitors to the majority of mankind, in spite of their good qualities.

All of our New Jersey bats belong to a single family, the *Vespertilionidæ*.

Family VESPERTILIONIDÆ.

Ordinary Bats.

Our Bats belong to five genera, distinguished as follows:

a. Membrane between the hind legs (interfemoral membrane), completely furred above, uniform with back. LASIURUS

aa. Interfemoral membrane naked or only slightly hairy near the base.

b. Fur black with white lips. LASIONYCTERIS

bb. Fur brown or yellowish brown.
c. Size large, length 4.60 inches. VESPERTILIO
cc. Size small, length 3.40 inches.
d. Fur dark glossy brown. MYOTIS
dd. Fur yellowish brown, somewhat mottled. PIPISTRELLUS

Genus VESPERTILIO Linnæus.

Vespertilio fuscus Beauvois.

Large Brown Bat.

PLATE 42.

Length 4.60 inches. Spread of wings 12 inches. Flight membranes naked, except the base of the interfemoral membrane. Fur silky; dark brown, rather lighter below.

Probably the commonest species of bat in the State, frequently entering houses and probably the species so frequent about the electric lights, although the identification of bats on the wing is not an easy matter, nor is it much easier to secure them by means of a gun, for their erratic flight and the gathering gloom make them anything but easy targets.

Scotophilus carolinensis Abbott, Cook's Geol. of N. J., 1868, p. 751.

Scotophilus fuscus Abbott, Cook's Geol. of N. J., 1868, p. 751.

Vespertilio fuscus Abbott, A Naturalist's Rambles, 1885, p. 448.

Adelonycteris fuscus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 33.

Eptesicus fuscus Rhoads, Mam. Pa. and N. J., 1903, p. 212.

Genus MYOTIS Kaup.

Myotis lucifugus (LeConte).

Little Brown Bat.

Length 3.40 inches. Spread of wings 9 inches. Wing membranes naked, except a narrow strip next the body. Color glossy brown, paler below.

This is a common species about the woods and open fields, apparently not congregating about houses, as do the red and large brown bats.

Another closely related species, says bat *Myotis subulatus,* with thinner membranes, longer ears and narrower skull, has the same range, and doubtless occurs in New Jersey, being easily confused with the present form. There is, however, no definite record.

(a) *Vespertilio lucifugus* Abbott, Cook's Geol. of N. J., 1868, p. 752.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 37.

Myotis lucifugus Rhoads, Mam. Pa. and N. J., 1903, p. 207.

(b) *Vespertilio subulatus* Abbott, Cook's Geol. of N. J., 1868, p. 751.—Abbott, A Naturalist's Rambles, 1885, p. 448.

Myotis subulatus Rhoads, Mam. Pa. and N. J., 1903, p. 208.

Genus Pipistrellus Kaup.

Pipistrellus subflavus (Cuvier).

Georgia Bat.

Plate 43.

Length 3.40 inches. Spread of wings 8.50 inches. Wing membranes thin, naked, except at base of the interfemoral membrane. Fur light yellowish brown, blotched or mottled with dusky, uniform yellowish brown below.

This species is not uncommon, occurring in the same localities as the little brown bat, with which it agrees in size, but it differs in color and in the quality of its fur, which is looser and not so silky.

Pipistrellus subflavus Rhoads, Mam. Pa. and N. J., 1903, p. 210.

Genus Lasionycteris Peters.

Lasionycteris noctivagans (LeConte).

Silver-Haired Bat.

Plate 44.

Length 4 inches. Spread of wings 9 to 10 inches. Interfemoral membrane sparsely haired. Color dark brown or black, with silvery white tips to the hair. Ear short and rounded.

A rather common species, flying early in the evening until dark.

Scotophilus noctivagans Abbott, Cook's Geol. of N. J., 1868, p. 751.

Vesperilio noctivagans Abbott, A Naturalist's Rambles, 1885, p. 448.

Lasionycteris noctivagans Rhoads, Mam. Pa. and N. J., 1903, p. 210.

Genus Lasiurus Gray.

Lasiurus borealis (Müller).

Red Bat.

Plate 45.

Length 4.40 inches. Spread of wings 11 inches. Base of wing membranes, whole of interfemoral membrane and base of ears densely furred. Fur bright, rusty red or grayish, strongly tinged with rufous, lighter below. Hairs generally tipped with whitish and a whitish patch before the shoulder on each side.

This is a very common bat, frequently entering houses in the summer evenings, as does the large brown bat, these two species being the best-known bats in the State. Some of the others are quite plentiful, but they do not so frequently fall into the hands of man, unless specially sought for.

Lasiurus noveboracensis Abbott, Cook's Geol. of N. J., 1868, p. 751.

Atalapha novæboracensis Abbott, A Naturalist's Rambles, 1885, p. 448.

Atalapha borealis Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 33.

Lasiurus borealis Rhoads, Mam. Pa. and N. J., 1903, p. 213.

Lasiurus cinereus (Beauvois).

Hoary Bat.

Plate 46.

Length 5.40 inches. Spread of wings 12 to 15 inches. Similar to the red bat, but much larger. Fur dark brown, mixed

with yellowish brown and tipped with silvery white. Whitish below.

A large northern bat migrating southward in winter, as do some of the other species.

The only record for the State of New Jersey is one recorded by Cooper (Annals of N. Y. Lyceum, 1848, vol. IV, p. 56), shot by J. F. Ward, in November, near the heights of Weehawken, Hudson county, N. J.

Lasiurus cinereus Abbott, Cook's Geol. of N. J., 1868, p. 751. —Rhoads, Mam. Pa. and N. J., 1903, p. 214.

Order CARNIVORA.

Flesh-Eating Mammals.

The cat and dog are familiar examples of the animals of this order. They are mainly flesh-eating and adapted for killing their own prey. The canine teeth, which are entirely wanting in the gnawing animals, are strongly developed, and the molars, instead of being flat-topped grinders, are surmounted with sharp cusps.

The legs are moderate, the feet of ordinary size, not elongated, as in the hoofed animals, and the claws are sharp and often retractile, or capable of being withdrawn into folds of the skin. Some carnivorous animals walk on the whole foot, as the bears, and are called plantigrade; others, like the dog and cat, walk on the toes and are called digitgrade. The several families of carnivorous mammals may be distinguished as follows:

a. Feet modified into flippers for swimming. PHOCIDÆ (Seals)
aa. Feet not modified into flippers.
b. Toes, five on all feet.
c. Size generally small, shape slender, tail long, sometimes black-tipped but never tinged. MUSTELIDÆ (Weasels, etc.)
cc. Size medium, tail long, bushy and tinged with black and white. PROCYONIDÆ (Raccoons)
ccc. Size large, tail very short, uniform in color with back. URSIDÆ (Bears)
bb. Toes, five on the fore feet, but only four on the hind feet.
d. Toes not retractile. CANIDÆ (Foxes)
dd. Toes retractile. FELIDÆ (Cats)

Family PHOCIDÆ.

Seals.

Seals are aquatic carnivorous animals wholly different from the whales with which they are often popularly associated by reason of their living in the sea. They have a head resembling that of the otter. The body is covered with hair, and the feet (all four of which are present), while modified into flippers, are also used to some extent to support the body when the animal rests on shore.

Such seals as have occurred in the waters of New Jersey are mere stragglers from far north, and only one species has occurred more than once, namely the harbor seal, which is found regularly as far south as the Maine coast.

Seals of two genera have occurred on the New Jersey coast:

a. A hood-like appendage on the head of the male; incisor teeth, two above and one below on each side. CYSTOPHORA

aa. No hood-like appendage on the head; incisors, three above and two below on each side. PHOCA

Genus Cystophora Nillson.

Cystophora cristata (Erxleben).

Hooded Seal.

Plate 47.

Length, 7 feet. Color, bluish-black above, lighter beneath; varied with whitish spots; sometimes light gray with dark spots. Recognized at once by the "hood-like" bag on the head of the male and by the small number of front teeth (incisors), four above and two below instead of six and four as in all other true seals.

One individual of this species was captured June 3, 1883, at Spring Lake, N. J., and lived for a short time in the Philadelphia Zoological Garden. It had probably come south on an iceberg (A. E. Brown, American Naturalist, Nov., 1883, p. 1191).

Cystophora cristata Brown, Amer. Naturalist, 1883, p. 1191—Rhoads, Mam. Pa. and N. J., 1903, p. 126.

Genus Phoca Linnæus.

Phoca vitulina Linn.

Harbor Seal.

Plate 48.

Length, 4 feet. Color usually yellowish gray spotted with black; beneath, yellowish white with small black spots. Often dark brown varied with light spots.

A few harbor seals probably come down the coast every winter, and reports of captures reach us every now and then from fishermen along the shore. Seals have been known to come up the Delaware as far as Trenton in severe winters, where Dr. C. C. Abbott recorded them in 1861, 1864, 1866, 1870, 1877, and eight in winter of 1878-79 (J. A Allen, N. A. Pinnipeds, p. 585). Mr. Rhoads records another taken at the same place in October, 1901 (Mammals Pa. and N. J., p. 125).

Phoca vitulina Allen, N. A. Pinnipeds, p. 585—Rhoads Mam. Pa. and N. J., 1903, p. 125.

Phoca groenlandica Erxleben.

Harp Seal.

Plate 49.

Length, 5 feet. Color, yellowish white, with face black and a curved black band down each side of the body, meeting over the shoulders and above the tail.

A seal reported by Dr. C. C. Abbott as captured in the Delaware near Trenton, in the winter 1878-79, was evidently of this species. (Allen Monograph Amer. Pinnipeds, p. 640.) It doubtless accompanied the unusual migration of harbor seals which occurred that season.

Phoca groenlandica Allen, Amer. Pinnipeds, p. 640.—Rhoads, Mam. Pa. and N. J., 1903, p. 125.

Family MUSTELIDÆ.

Otters, Weasels and Skunks.

This group comprises our smaller carnivorous mammals, of which the weasel may be regarded as a typical representative. The larger Pine Martin (*Mustela americana*) and Fisher (*M. pennantii*) no doubt formerly occurred in the mountainous parts of northwestern New Jersey, but there seems to be no definite record of the fact. It is possible also that another species of weasel, *P. cicognani,* may have occurred in the same region. At the present time only four species of *Mustelidæ* are to be found in the State, belonging to three genera, as follows:

a. Toes webbed, teeth i 3/3, c 1/1, p 4/3, m ½. LUTRA
aa. Toes not webbed.
b. Teeth i 3/3, c 1/1, p 4/4, m ½. MUSTELA (extinct in N. J.)
bb. Teeth i 3/3, c 1/1, p 3/2–3/3, m ½.
c. Colors black and white. MEPHITIS
cc. Colors brown (sometimes white in winter). PUTORIUS

Genus Lutra Brisson.

Otters.

Lutra canadensis lataxina (Cuvier).

Carolina Otter.

Plate 50.

Length, 3 feet 6 inches to 4 feet. Body long and somewhat flattened, feet short, toes webbed, tail very broad and flat at the base, where it joins the body. Color, seal brown, lighter beneath, pale brown on the throat.

Although rarely seen, otters still remain in more secluded localities along the streams and lakes of the State. They are thoroughly aquatic animals, with webbed toes, and are adepts

in the art of swimming and diving. This combined with their nocturnal habits make it quite possible for them to remain undetected in comparatively thickly settled districts. They are fish-eaters, and are seldom found far from water except when traveling over land to take up their abode on another stream.

In studying the structure and habits of the otter one does not have to practice much imagination to see the line of evolution followed by the seals in their departure from the terrestrial Carnivora.

Mr. Rhoads in an article in *The Friend,* February 24th, 1894, described an otter's "den" which had been accidentlly opened in cutting away a bank of Pensauken creek near Lenola, N. J. It was a very large cavity, some six feet below the surface of the ground, and with a passage-way leading out to the bed of the creek some distance away; another tunnel branched off leading to another smaller chamber. From the location of the entrance in the bed of the creek and absolute absence of any external trace of their habitation, the otters could readily have resided in this spot, as they evidently had done, for many years without being seen.

One peculiarity of the otter is, however, likely to attract attention to his presence, and that is his habit of sliding down a steep muddy bank into the water. This is apparently done in sport, and the slide is worn smooth and slippery from use. Such slides are often detected by those who are familiar with their nature, and such discoveries often lead to not only a sight but often the death of the otter.

The pelts of the otter have always been a valuable source of revenue to the hunter, as are those of all the family *Mustelidæ.*

Lutra canadensis Abbott, Cook's Geol. of N. J., 1868, p. 754.—Abbott, A Naturalist's Rambles, 1885, p. 448.—Rhoads, The Friend, Feb. 24th, 1894.—Rhoads, Mam. Pa. and N. J., 1903, p. 156.—Beesley, Geol. Cape May Co., 1857, p. 137.

Lutra hudsonica Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.

Genus Mephitis Cuvier.

Skunks.

Mephitis mephitica putida (Cuvier).

Eastern Skunk.

Plate 51.

Length, 2 feet. Body covered with long hair; tail very large and bushy; color, black with a white patch on the back of the neck, from which two stripes extend down the back and along the sides of the tail, and a white stripe down the forehead. The extent of the white stripes varies greatly.

The skunk is well known everywhere but owes his notoriety to our sense of smell rather than sight. The peculiar scent with which nature has provided him and which he discharges freely when disturbed serves him well as a means of protection, and he travels about at dusk comparatively free from molestation. The great horned owls and other predatory birds or mammals occasionally catch skunks, but probably not unless driven by hunger.

The skunk shares with the other members of this family, the enmity of the farmers for inroads upon their poultry yards, but he is far less injurious than the allied mink and weasel, his rather clumsy gait and terrestrial habits make him but a poor chicken thief compared with his more agile relatives.

The main food of the skunk is found in the woods and fields, and consists of beetles, bugs, grasshoppers and larvæ of all sorts of ground-living insects, so that in this way he does us a benefit which, perhaps offsets the damage that he is responsible for.

In winter time skunks seek their burrows and spend a large part of the cold weather sleeping under ground. These burrows are in the woods or along old fences, in old orchards, etc. Sometimes I feel sure they are simply deserted burrows of the woodchuck. A whole family of six to eight will often be found in one hole.

The skin of the skunk is a valuable article in the fur trade, and large numbers of them are secured by trappers every year, and later sold by the furriers under more attractive trade names.

Mephitis mephitica Abbott, Cook's Geol. of N. J., 1868, p. 754.—Abbott, A. Naturalist's Rambles, 1885, p. 448.—Rhoads, Proc. Acad. of Nat. Sci. Phila., 1897, p. 31.

Mephitis americana Beesley, Geol. Cape May Co., 1857, p. 137.

Mephitis mephitis putida Rhoads, Mam. Pa. and N. J., 1903, p. 163.

Genus Putorius Cuvier.

Minks and Weasels.

Putorius vison lutreocephalus (Harlan).

Southern Mink.

Plate 52.

Length, 28 inches. Larger than the weasel, with thicker tail; dark chestnut brown with a white spot on the chin and often on the chest or belly.

The home of the mink is in low ground along a water course, and in a nearby bank it usually digs its burrow and rears its young. It is far more acquatic than the weasel and dives and swims with ease. The mink lives to some extent upon fish, but also eats the meadow mice, and other semi-acquatic animals which frequent the meadows. Birds are also killed by this blood-thirsty little animal and their nests despoiled, and a convenient chicken house is by no means ignored, although the mink is not so destructive to poultry as the weasel.

The mink has always been persistently hunted, and its fur is highly valued. The mink like the skunk is provided with a scent gland, and, although it does not use it as a means of defence, its odor is to me far more disagreeable at close range than the odor of the skunk.

Only one variety of mink is known from New Jersey, but to the north and in the higher mountains of Pennsylvania occurs

a smaller, blacker race—the northern or mountain mink *Putorius vison.*

Putorius vison Abbott, Cook's Geol. on N. J., 1868, p. 754.—Abbott, A Naturalist's Rambles, 1885, p. 448.—Beesley, Geol. Cape May Co., 1857, p. 137.

Putorius vison lutreocephalus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.—Rhoads, Mam. Pa. and N. J., 1903, p. 167.

Putorius noveboracensis (Emmons).

New York Weasel.

PLATE 53.

Length, 16 inches; female, 13 inches. Tail always more than a third of the total length. Dark chocolate-brown above, white below, terminal third of the tail black. In winter, in the northern part of their range, Weasels usually turn pure white except for the black tip to the tail.

The weasel is the most blood-thirsty of all his tribe. He is strictly carnivorous and hunts his prey continually, often killing rabbits, mice and squirrels, just to suck their blood, and, one victim disposed of he is off on the trail of another. When he visits the poultry house he not infrequently kills all of the inmates that he can reach without stopping to devour any one of them. Weasels live in holes in the woods, along old walls and fence rows or among piles of rock, and sally forth mainly at night on their hunting expeditions. The weasel's long, slender body often humped on the back as he runs, and his vicious little face recall somewhat the appearance of a snake, and his wonderfully rapid motions increase the resemblance. I have seen one white weasel from Central New Jersey, but, as a rule, they do not change pelage so far south. This change is really a change of pelage, all the brown hair being shed and new white fur assumed. The individual hairs do not change color as is sometimes alleged.

Near Medford, N. J., I once watched a weasel making repeated journeys from its burrow in the woods to an adjoining swamp and returning at intervals of five or ten minutes each

time with a meadow mouse in his mouth, which was stored away in the burrow. I saw him bring in six while I watched, and each time he reached the swamp by exactly the same route.

The smaller, Bonaparte's Weasel occurs farther north and may sometimes occur in the northwestern counties. It has a shorter tail, not exceeding one-quarter of the total length.

Putorius noveboracensis Abbott, Cook's Geol. of N. J., 1868 p. 753.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.—Rhoads, Mam. Pa. and N. J., 1903, p. 170.

Putorius ermineus Abbott, A Naturalist's Rambles, 1885, p. 448.

Mustela pusilla Beesley, Geol. Cape May Co., 1857, p. 137.

Family PROCYONIDÆ.

Raccoons and Their Allies.

These are small or medium-sized bear-like carnivorous animals of which only one species, the common raccoon occurs in New Jersey.

Genus Procyon Storr.

Raccoons.

Procyon lotor (Linnæus).

Raccoon.

Plate 54.

Length, 32 inches. Hair long, rather coarse. General color gray, hair dusky or black at the tip, darker on the back; face whitish, with a black area on each cheek surrounding the eye; feet black; tail bushy, grayish white, with black rings.

Though a member of the carnivora the raccoon is quite willing to devour any sort of fruit that comes in his way, and is particularly fond of fresh corn. Small animals he also devours, as well as eggs of both domestic and wild fowls and fowls themselves when opportunity offers.

Though persistently hunted and valued for his fur, as well as an article of food, the coon seems to hold his own. He goes about at night and during the day retires to his den dug out among the roots of some old tree or under a rock. During severe weather they retire to their burrows and sleep until the temperature moderates.

Procyon lotor Abbott, Cook.'s Geol. of N. J., 1868, p. 754.—Abbott, A Naturalist.'s Rambles, 1885, p. 448.—Beesley, Geol. Cape May Co., 1857, p. 137.—Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.—Rhoads, Mam. Pa. and N. J., 1903, p. 182.

Family URSIDÆ.

BEARS.

Only one species of this well known family occurs in the State.

Genus URSUS Linnæus.

Typical Bears.

Ursus americanus Pallas.

Black Bear.

PLATE 55.

Length, 5 feet. Color black, with a brownish tinge on the face. The general build of the bear, its short tail and plantigrade walk are well known.

Black Bears, except under extraordinary circumstances, are in great fear of man and make every effort at escape or concealment when danger in this form menaces them. Their food consists almost entirely of nuts, berries and such insects, mice, etc., as they can dig out from stumps or catch from under overturned logs; occasionally, however, they will kill sheep or pigs if forced by hunger to trespass upon clearings or farm land. Wild bees' nests are their delight, for honey they prefer to any other food. Young bears are curious little naked creatures, exceedingly small for the size of the parent. They are born in the

winter, and the female usually remains in the den with them until spring.

Bears are rapidly approaching extinction in New Jersey, being now, probably, found only in some of the more remote cedar swamps of the pine barrens. In 1902 several newspaper articles described the presence of a bear in Blackwater swamp, near Vineland, and according to Mr. Rhoads' correspondents, they occurred in Manahawken swamp as late as 1890. As evidence of their existence at the present time, I may state that in October, 1907, Mr. J. W. Holman of Stafford's Forge, near West Creek, found tracks of an old and young bear extending for one-half mile along a swampy road leading up to the East Plains, some 7 miles from West Creek.

Ursus americanus Abbott, Cook's Geol. of N. J., 1868, p. 755.—Beesley, Geol. Cape May Co., 1857, p. 137.—Rhoads, Mam. Pa. and N. J., 1903, p. 183.

Family CANIDÆ.

Wolves and Foxes.

This is the family of which the dog is the type. The wild representatives are known as wolves and foxes. The former have long since been extinct in New Jersey, but two species of foxes are still found in the State.

The animals of this family agree with the cats and differ from the bears in being digitigrade instead of plantigrade and in having only four toes on the hind feet. From the cats they differ in their duller, non-retractile claws, as well as in skull characters, and notably in habits. They are mainly terrestrial.

Genus Vulpes Brisson.

True Foxes.

Vulpes fulvus (Desmarest).

Red Fox.

Plate 56.

Length, 40 inches. Fulorus or red, grayish on the rump and flanks; hair of the tail black toward the end, tip of the tail whit-

ish, legs black, partly white on the inside; throat white, ears tipped with black.

The cunning of the fox both in robbing the hen roost and in eluding his pursuers is well known to everyone; and it is to the present species that all the stories of shrewdness pertain, the gray fox being an animal of quite different character.

The food of the red fox besides poultry, consists of all sorts of wild birds, and all of the smaller quadrupeds from the size of a fawn and woodchuck down to the smallest mice; insects, too, form part of his diet when nothing better is to be found.

Foxes have their dens in the woods, usually dug out in some rocky locality, and here the young are reared. I have known young foxes to become quite tame when kept in captivity, but only allowed one person who was constantly near to handle them. Of the rest of the family or strangers they always were more or less afraid.

Red foxes from the earliest days have been regularly pursued by fox hunters with their packs of hounds, and an old fox will lead them a long chase, rarely going to earth unless completely worn out. In the more thickly settled parts of the country foxes are often protected by lovers of the sport expressly for hunting, and there is many a difference of opinion between the hunter and the farmer on the question of shooting these animals. Sometimes too, foxes are introduced from elsewhere when they have become well-nigh exterminated, and Mr. Rhoads presents pretty conclusive evidence that the red foxes of lower New Jersey, Pennsylvania and southward are the descendants of foxes originally imported from England for hunting purposes. The earliest records quoted by Mr. Rhoads show that the gray fox was the only one then known to the inhabitants (see Mammals of Penna. and N. J., p. 145).

Vulpes fulvus Abbott, Cook's Geol. of N. J., 1868, p. 753.—Geol. Cape May Co., 1857, p. 137.—Rhoads, Mam. Pa. and N. J., 1903, p. 145.

Vulpes pennsylvanicus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.

Genus Urocyon Baird.

Gray Foxes.

Urocyon cinereoargenteus (Schreber).

Gray Fox.

Plate 57.

Length, 39 inches. General color gray, hair banded black and white, darker on the back, sides of the neck, ears and band across the breast rusty, tips of ears black, feet rusty, as well as the under surface of the body. Inner side of legs, throat and middle of the breast white. Tail much coarser than that of the red fox with no soft under fur.

This is the common fox over the greater part of New Jersey. It is an inhabitant of the woods and wilder sections of the country, and avoids the vicinity of man's habitation.

Consequently while partaking of pretty much the same bill of fare as the red fox it is less destructive to poultry.

The gray fox will not run before the hounds as does the red fox, but seeks safety in concealment, and is soon run to ground.

Vulpus virginianus Abbott, Cook's Geo. of N. J., 1868, p. 753.—Beesley Geol. Cape May Co., 1857, p. 137.

Urocyon cinereoargenteus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 31.—Rhoads, Mam. Pa. and N. J., 1903, p. 143.

Family FELIDÆ.

Cats.

The wild allies of the domestic cat in eastern North America were three in number, the cougar, *Felis couguar,* Canada lynx, *Lynx canadensis,* and the wild cat, *Lynx ruffus.* The first was long since exterminated in New Jersey, as was also the second, if indeed it ever occurred south of the New York state line, but the last still occurs in wilder sections of the State in small numbers.

Genus Lynx Kerr.

Lynxes.

Lynx ruffus (Guldenstædt).

Wild Cat, Bob Cat.

Plate 58.

Length, 38 inches. Legs rather long, ears tufted, tail very short (not over six inches). Color yellowish brown, tinged with rufous (much redder in summer), spotted with dark brown or black, narrow black lines on the head and a stripe down the back, chin and throat white, below, white spotted with black.

Once abundant but now on the verge of extinction in New Jersey. At the time of publication of Mr. Rhoads' work on the Mammals of Pennsylvania and New Jersey, 1903, it was reported extinct except in the most northern counties where some were thought to linger, while three recent records of wild-cats killed in Mercer county are given in 1885, 1891 and 1892.

Wild-cats are vicious animals, not hesitating to attack man when cornered, and preying on all the birds and mammals of the forest, as well as poultry, and young sheep and pigs.

Their dens are located in hollow trees or in rocky ledges.

Lynx rufus Abbott, Cook's Geol. of N. J., 1868, p. 753.—Abbott, A Naturalist's Rambles, 1885, p. 447.

Lyncus rufus Beelsey, Geol. Cape May Co., 1857, p. 137.

Lynx ruffus Rhoads, Proc. Acad. Nat. Sci. Phila., 1897, p. 32.—Rhoads, Mam. of Pa. and N. J., 1903, p. 141.

PART III.

THE KING CRAB FISHERIES IN DELAWARE BAY,

And Further Notes on New Jersey Fishes, Amphibians and Reptiles.

BY HENRY W. FOWLER,

Of the Academy of Natural Sciences of Philadelphia.

1. The King Crab Fisheries In Delaware Bay.

Professor George H. Cook as long ago as 1856 gave the first important account[1] of the king crab (*Limulus polyphemus*) in the waters of the bay shore of Cape May county. I cannot do better, for comparison, than quote freely from his article. He says that immense numbers of this animal come in shore at the season for depositing their eggs, which is in the latter part of May and in June. The whole strand for many miles would be covered with them, sometimes 2 or 3 deep. A resident of Town Bank reported that on his shore of 100 rods he could get 100,000 in a week. On about half a mile of the strand 750,000 were taken in 1855, and 1,200,000 were taken on about a mile in 1856. The king crab deposits its eggs, and then leaves the shore entirely till the same season the next year. But little if anything is known of their habits or localities during the interval. The number of eggs is very great. They have been so thick along the shore that they could be shoveled up and collected by the wagon-load. Great numbers have thus been gathered up and carried away to feed chickens. When they hatch the sand is fairly alive with the little creatures. On one occasion a vessel took in a load of sand on the shore, and in two or three days so many of these young king crabs appeared in it that the whole cargo was thrown overboard. Hogs will eat king crabs with avidity, and it is a common practice to gather them for that purpose during the season. They seem to act as a tonic to most hogs, and are very desirable food for them. The usual practice is to gather king crabs into pens and allow them to putrefy, forming a kind of compound, to be used as manure. They have also been composted for the same purpose. For raising of wheat they have been very successfully used. On land which would not grow wheat at all up to that time, crops of 20, 25 and even 30 bushels to the acre have been

[1] Geol. Cape May Co., N. J., 1857, p. 105.

raised by the use of these crabs composted with earth. It has been thought by some that they injure the ground for the succeeding crops of corn or grass, and that they promoted the growth of sorrel. Many persons, however, have continued their use for years in succession, with success. A resident of Fishing Creek used them, in compost, every year with the best effects on early potatoes. A remarkably fine and thrifty young orchard of his was manured principally with crabs in their raw state. Another resident of Dias Creek used them for a number of years, composting them with saw-dust, coal-pit bottoms, mud and barn-yard manure. With a compost of 7,000 crabs, 22 loads of mud, 2 coal bottoms, 7 or 8 loads of old hay and manure, applied on 6 acres of sandy loam, he raised 151½ bushels of wheat. On another field, where the crop succeeding that manured with crabs did not look thrifty, he sowed a light dressing of quick lime. The crop immediately began to improve, and turned out to be an excellent one. A resident of Dias Creek had an acre and a half of sandy loam on which was raised all the corn and wheat needed for the family use for fifteen years. He had it in two fields, and raised corn in one and wheat in the other, every year giving each field a two years' rotation. Occasionally he ploughed in the wheat stubble and raised a crop of buckwheat, thus getting three crops from the same ground in two years. The straw and stalks were all taken off the field, and the only manure that was applied was a compost of 2,000 crabs, with eight or nine loads of sods from the fence corners each year. The compost was all put on the wheat, the manure being used on the corn. The sorrel grew very rank in the corn, but was kept down by hoeing. His first crop of wheat on ninety rods of ground was 16 bushels, weighing 65 pounds to the bushel, and his wheat usually yielded at the rate of from 25 to 30 bushels to an acre. His corn crop was at the rate of 30 to 50 bushels an acre. When he stopped gathering crabs and used lime his crops were not as heavy as before. He thought they were falling off while using crabs, but others thought they had not fallen off more than was due to the variation in seasons. These cases are sufficient to show the value of the manure. Allowing the king crabs to lie in piles and decompose themselves is very wasteful, and the com-

posts where usually made have had by far too small a quantity of absorbent material added, as is evident from the escape of the gases from the heaps, as well as from the results of experience in making composts in other localities. The crabs, when alive, weigh 3 to 4 pounds, and when thoroughly dried they average nearly if not quite a pound each. To save all the gases which will escape from them in the course of their decay, not less than five times their weight of muck, sods, loam, or other absorbent material should be used, and a much larger quantity would not be injurious. Some have ground them for use as a concentrated manure, and a mill was erected at Goshen for that purpose. The crabs were dried, ground as fine as possible, and mixed with a small quantity of deodorizing material. This material, thus prepared and put up in bags sold under the name of cancerine. Its price was $25 to $30 a ton at the works.

Professor Cook's remarks hold good in the main even at the present time, so far as I have been able to investigate. The crabs certainly appear in great numbers now. Most persons think they are not so abundant as formerly, though in the case of last season they were a little late, owing to the protracted cold weather, still they were more abundant than during the past fifteen years at least. They were present, however, in unusual abundance, and some of the largest catches were recorded. They appear, however, to be decreasing year by year. The introduction of pound-nets into the region about 1870 may have had some influence on their abundance, which appears to be somewhat erratic. They do not always appear in Cape May waters in the same quantities, and it is said that when they are scarce there they are usually correspondingly numerous on the Delaware shores. For this reason, in one case, a factory was moved across the bay with success. They apparently do not leave the bay, as they are dredged up at other times of the year by the oyster-dredgers. Although young and adult king crabs are numerous, those of intermediate size seem to be very scarce, and seldom one is taken. When ready to spawn the king crab moves in towards shore, always on the flood tide, and especially if there is an unusually high tide at the time of full moon. Some writers think it very likely that the same individuals may deposit eggs more than once

each year. The eggs and milt are placed in hollows, the animals while in copula remaining more or less completely buried in the sand. Then only the back of the bull may be seen. The male mounts from the back, and it is thus very common to find them paired, though frequently more than one male is found attached to a single female. As many as four males have been found attached to a single female. When so many are found together, they may be attached in various positions, though the male which is attached over the tail usually always remains fastened firmly, so that it is possible to throw them together into the boat. The other males mostly drop off more readily when disturbed. When the crabs retreat or move away, the eggs become covered with sand. I have found that they spawn in late May and early summer, and by some it is claimed they spawn throughout the summer. The eggs are small, very numerous, have great vitality, are of a livid white color, and difficult to distinguish from the sand. They hang together in an adhesive mass, though they are not viscous, being easily rubbed apart. The young animal looks very much like a young trilobite, and swims very easily. They rotate very rapidly in the egg when disturbed. The spine, it is said, does not appear until after the first moult, when the animal begins to resemble the adult. The king crab prefers such conditions as are offered in Delaware Bay, where there are muddy or sandy bottoms, and it is seldom or unusual to find them along the ocean beach. They also prefer more or less tranquil water where there is little or no surf. They burrow in these places just under the sand or mud, and there find an abundance of food in the many small animals, and are said to feed principally on worms. Although a creature without any means of offense to most animals, such as fishes, they are amply protected from most enemies by their hard covering. The strong spine is used to right themselves when overturned. They progress through the sand by crawling, and when burying themselves are assisted by means of the hinged back, and also the spine. They are good swimmers, though may frequently be seen crawling about over the bottom. When in shoal water they may easily be discovered by means of two rows of small bubbles constantly appearing at the surface of the water. The sexes differ very much in size,

the female always reaching much larger dimensions. The male may easily be distinguished by the first pair of legs having the fingers bent over the thumb and swollen, and a longer spine proportionately.

The bay shore all along Cape May county is admirably adapted for the erection of the long pounds one finds there. The low-water mark is far from that of high-water, leaving immense flats, all sandy, and in most places covered with muddy ooze. These pounds as mentioned before extend out from shore to low-water mark or a little beyond, which in some cases is several hundred yards, or about 2,100 feet. They are placed according to property lines. They are formed of long poles made of small trees or saplings, and long enough to be well above water at high-tide. These poles are driven well down into the sand, and are exposed about 7 or 8 feet at low-water. According to the length of the pounds the bowls are arranged from a single terminal one with two or three more at equal distances. Each bowl has at least two compartments, the outer for the fish and the other for king crabs. On each side of these bowls are wings, producing a V-shaped appearance, the opening being at the apex. At this latter point all the animals pass into the bowl. This is facilitated, in the case of the king crabs, usually by a short inclined board at the bottom of the entrance to the inner or first compartment. The king crabs readily crawl over this, and thus find themselves entrapped as the tide retreats. The only opening into the outer compartment is blocked by several stout wires, which while preventing them from getting into it, allow the fish to pass freely through. The object of this is to keep the fish from being constantly bruised by the ever restless crabs, should they happen to get in. Fish so found with the crabs were nearly always dead or dying, and in bad condition from their rough treatment. Ordinary galvanized poultry-yard wire is used as netting in these pounds, with about a 2-inch mesh. Formerly cotton-netting, similar to fish seines, was used. Sometimes they were made solid with gum poles. As the poultry-wire does not weather more than a season it is necessary to replenish it every year. The actual cost of a single pound-net varies, according to length, from $50 to $200. The fishermen or owners of these pounds

fish them twice a day or at low water. They drive out to the bowls in their wagons and load the crabs and fish directly. The crabs are then hauled to the beach, where, opposite each pound and up on the high dry bank, a large pen is erected. This is frequently of various construction, and while usually made of wire like that in the pounds is frequently built up of boards or rails, etc. The size of the pen is usually in accordance with the expected catch, and as this is estimated fairly well, it varies. The largest pen, which was really divided, contained altogether about 300,000 crabs. Others of all sizes ranging down to as low as 25,000 were noted. Some pens when not large enough are frequently added to. We saw several which were filled to overflowing and had bursted, leaving great masses of the animals all about their sides. They are frequently emptied and then filled again. By the method in vogue in fishing the pound, and continually adding crabs, there are always a number of live individuals in the pens. They, of course, are those forming the surface layer. The crabs live about two or three days, and as the pens are high and dry here and there those which had attempted to escape were always found dead or dying in the hot dry sand. They always appear to be more restless in the pens at the flood tide, when they produce much more commotion than at other times. The king crab appears to be able to determine the time of high-tide even when far removed from the water, as they are then very restless. So far as I could determine the sexes appear equally abundant. The pens when full of crabs always produce a stench, though this is not so foul unless at close quarters or in the wind. The decomposition of animal matter thus going on conduces to myriads of maggots and insects swarming about. These are frequently and greedily devoured by most common birds, such as red winged blackbirds, grackles, flickers, crows, etc. It is also said that the birds feed their young with them, and that their nests have a correspondingly unsavory odor. Many birds were seen flitting about the pens and feeding. As the owners of the pens and pounds count the individuals of their catch as they store it up, they have a fairly accurate knowledge of the respective contents of the pens. At the end of the season the crabs are removed and loaded in boats, and then shipped up the river to the fertilizing

plants. Most of them are shipped to Paulsboro. In this way all the pens are emptied. Such material as was formerly reserved for home use was generally ground up by small wooden machines made for the purpose, or with flails like those used for threshing. I have been informed that the usual price received for the crabs is $8 per thousand, thus a good catch will net an owner quite a fair profit during a single season.

I am indebted to Mr. Bartram W. Griffiths for the accompanying photographs, and to Mr. H. Walker Hand for information and many favors while conducting our trips and investigations.

2. Further Notes on New Jersey Fishes.

My observations on the fishes of the State during the past season, or since my supplement in last year's report was prepared, are all recorded in this paper. In a recent number of Science, the interesting discovery of "Gambusia in New Jersey" is noted. This is a small fish of interest chiefly to mosquito investigators for its destruction of the larvæ of the malarial mosquito, *Anopheles*. Other rare and interesting species have been found in New Jersey waters and examined. In Professor J. B. Smith's Rep. N. J. Agr. Exper. Sta., 1904, I have previously neglected to call attention to Mr. William P. Seal's interesting notes on the mosquito-devouring fishes. Dr. W. C. Kendall, of the Bureau of Fisheries, Washington, D. C., has kindly furnished me with some interesting notes.

Family PETROMYZONIDÆ.

Petromyzon marinus Linnæus.

Lamprey.

Reported to occur in Cedar Swamp Creek at times about Petersburg, though in tide-water.

Mr. J. B. Vanderveer reports that in his experience the lamprey is quite bold when spawning, and resists intrusion, though harmless. Their bodies appeared in contact when the ova was extruded. He found them in the Delaware about Trenton in early summer, though small, and ascending or swimming with the common eel, *Anguilla*. On one occasion three were seen on a single shad, of which one was fastened on each gill-opening and the other at the vent.

A small example in the *Ammocœtes* stage was taken in Edward's Run, tributary of Mantua Creek, in Gloucester county, November 3d, 1907, by B. W. Griffiths and H. W. Fowler.

Family CARCHARIIDÆ.

Carcharias littoralis (Mitchill).

Sand Shark.

Head $5^{2}/_{3}$; depth at origin of pectoral probably about $8\frac{3}{4}$; width of head $1\frac{1}{2}$ in its length; depth of head at first gill-opening $1\frac{7}{8}$; snout, measured from tip around to front of eye, $3\frac{2}{5}$; width of mouth $2\frac{1}{3}$; interorbital space $3\frac{1}{5}$; space between front of mouth and tip of snout about $1\frac{2}{5}$ in its width; front margin of first dorsal about $2\frac{1}{3}$ in head; front margin of second dorsal $2\frac{2}{3}$; front margin of anal $3\frac{3}{4}$; front margin of lower caudal lobe about $2\frac{1}{3}$; least depth of caudal peduncle about 5; upper margin of pectoral about $1\frac{4}{5}$; front margin of anal about $2\frac{3}{4}$. Body elongate, rather slender, apparently more or less cylindrical, depressed anteriorly, with pharynx rather swollen as usual, and trunk tapering back from base of pectoral long and slender. Edges of body flattened, or convex, without median longitudinal groove, and no evidence of a pit at origin of either caudal lobe. Caudal peduncle slender, its least depth about equals its length. Head rather broad, blunt, depressed, and apparently equally convex below and above. Profiles apparently similar. Snout rather small, pointed, protruding somewhat, and as viewed above rather angularly convergent, with its length about three-quarters its width. Eye small, supero-lateral, placed near first third in length of head, evidently elongate. Mouth large, length of gape about half of its width, and symphysis falls apparently about midway in length of snout. Lips firm and tough. At angle of each jaw, a fold inside equal to about one-third length of each mandibular ramus. Teeth in jaws large, decreasing in size towards ricti, where they are short and much smaller, mostly tricuspid, with median cusp very long, slender and sharp-edged. Some of larger teeth with 3 or 4 basal cusps, as 2 on each side. All basal cusps small. Nostrils inferior, lateral, about half-way in snout to eye, internasal space about half of interorbital, and nasal flaps small. Interorbital space comparatively narrow and rather slightly convex. Gill-openings 5, all in front of origin

of pectoral, and third largest, or about equal to length of snout. Spiracle minute, supero-lateral on head posterior to eye space about half of interorbital width. Body covered with fine shagreen denticles of uniform size, and all rather rough. Origin of first dorsal nearer tip of snout than last vertebra, or a little nearer that of ventral than base of pectoral, fin low, rather rounded, its apex near base of its posterior margin, and posterior blunt point 3½ in interorbital space. Second dorsal but little smaller than first, similar, well before ventral, and inserted about first $^3/_7$ in space between origin of first dorsal and last vertebra. Anal about equal to second dorsal, and inserted about opposite posterior basal portion of same. Caudal rather small, greatest width of upper lobe about 7 in its length. Height of lower caudal lobe about 2⅘ in its base. Pectoral rather broad, short, its insertion but little nearer that of first dorsal than corner of mouth, and its greatest width about 1⅔ in its length. Ventral broad, rounded, and inserted a little nearer first dorsal than second. No claspers. Color of dried skin dull gray-brown, paler below, or lighter gray on lower surfaces of pectoral and ventral. Teeth white. Length 8 feet 9 inches. Beesley's Point. This is the example quoted from Dr. Abbott in the Report for 1905.

A large shark taken in the summer of 1888 was evidently this species. It was calculated to have weighed not less than 600 pounds, and measured 14 feet in length. When opened it contained 1 to 1½ bushels of fish. It was believed to occur in the locality, near Palermo, in Cape May county, for 3 or 4 years.

It is very probable that some of the large sharks seen about Cape May, though few have been taken which measured over 8 feet in length, may be this species. They are usually called "shovel-nosed shark." Though one hears the name "mackerel shark," it is evidently confused with this species at times. An example about 2 feet long was found in one of the pounds at Green Creek, Cape May county, on June 9th, 1907. It was of a dull sandy-brown color, generally with belly and lower surface of head whitish. The species was reported to occur occasionally there, and sometimes to reach a large size.

Reported at Barnegat Pier on July 30th, 1907. Reported at Ocean City, and said to reach a length of from 8 to 10 feet.

Occurs occasionally in the Great Egg Harbor Bay about Beesley's Point and Somers Point. One was reported from Cape May in the past August, about 6½ feet long, which weighed about 225 pounds. The teeth were sold by beach fakirs for a dollar apiece.

Dr. Kendall writes, "one time while off Cape May, in the Grampus, we sighted a school of large fish making considerable commotion in the water. A dory was lowered, and we went out to investigate. We found that it was a school of large *Cynoscion regalis* and sharks feeding upon anchovies (*Anchovia mitchilli* most likely). I think the sharks were *Carcharias littoralis,* as they were broad-nosed fellows. We gaffed a dory load of the weak-fish, and they were large ones."

Family ALOPIIDÆ.

Alopias vulpes (Gmelin).

Thresher Shark.

Mr. O. H. Brown tells me, that according to Mr. Henry Bohm, about 11 or 12 years ago this fish appeared in the neighborhood of the steamboat landing at Cape May, and was seen for several days, occasionally mixing with schools of porpoises, when it threshed the water with its tail like those seen in the bay some years before. One day it came under the steamboat wharf and became confused in the piling. The next day Mr. Bohm found it dead in his fish-pound, which stood a few hundred yards further up the beach. Mr. Bohm estimates its body was between 6 and 7 feet long, and as the tail was nearly as long as the fish, it would have measured between 13 and 14 feet from snout to tip of tail. The tail was preserved for several years. Those seen by Mr. Brown some years previously in Delaware Bay were probably 4 or 5 in number, and were swimming along with a number of porpoises off Higbee's Beach. The weather was calm, and more or less still, so they were easily observed. The sharks were first noticed as they swam with their long tails protruding some distance, and then they would let them fall on the surface

of the water, causing considerable noise and disturbance. In size they measured 5 or 6 feet. Called "thresher" or "thresher tail."

Mr. W. J. Fox says it has been reported by the fishermen of Sea Isle City, at times, to occur off shore and about the pounds.

Dr. C. C. Abbott tells me a small example was taken, in July of 1864, in the inlet back of Atlantic City. He says it was captured on a hook, and measured about 2 feet in length.

Family GALEIDÆ.

Cynais canis (Mitchill).

Dog Shark.

Taken by fishermen in Grassy Sound, Cape May county, on September 4th, 1897. It was taken at Atlantic City on August 25th, 1900, by Mr. J. A. G. Rehn, and September, of 1900, by Mr. C. W. Buvinger. Reported plentiful off Sea Isle City on August 15th, 1905, and one taken October 15th. Mr. W. J. Fox reports one taken April 29th, 1906, at Sea Isle City, also on July 15th, and again on July 23d.

Mr. H. Walker Hand says it occurs at Cape May about the inlets, sounds, and along shore. It runs up Delaware Bay in the pounds to Green Creek at least, and most likely further. About 6 examples were seen in the pounds at Green Creek, June 9th, 1907. The largest were about 2 feet in length. A small one was seen at Green Creek on June 23d. Reported at Barnegat Pier on July 30th, 1907.

Galeocerdo tigrinus Müller and Henle.

Tiger Shark.

Large spotted sharks, evidently this species, were reported by the fishermen at Sea Isle City, late in July of 1907.

Carcharhinus obscurus (Le Sueur).

Dusky Shark.

Head 6; depth, at origin of pectoral, 6½; width of head $1^1/_{11}$ in its length; depth of head, at first gill-opening, 1⅕;

snout, measured around from its tip to front of eye, 2½; width of mouth 2; interorbital space 1⅔; space between front of mouth and tip of snout 2 in its width; front margin of first dorsal about 1⅔ in head; base of first dorsal about 1¾; front margin of second dorsal $3^5/_7$; base of second dorsal 3⅗; front margin of anal 3¾; base of anal 4⅞; least depth of caudal peduncle 4¾; front margin of lower caudal lobe 1; pectoral along upper margin 1; width of pectoral at base $2^5/_6$; front margin of ventral 3⅖; length of ventral $2^4/_7$. Body elongate, depressed, and trunk tapering back long and rather slender from base of pectoral, at which point its greatest depth. Edges of body dorsally and ventrally evenly convex, and without a median depression. In profile contour similar above and below, with pharynx robust and cylindrical. Caudal peduncle rather cylindrical, comparatively slender, and its least depth about half its length. At origins of both caudal lobes a transverse crescentic pit. Head large, very robust, greatly depressed, though perhaps a little more evenly convex and less flattened below. Profiles similar, and when viewed above edge is seen as very broadly convex. Snout very broad, depressed, its margin not very trenchant, and its length about half its width. Eye small, lateral, and near first third in length of head, evidently elongately ellipsoid. Mouth very broadly and evenly convex, its length about half its width, and symphysis forms about last fifth in length of snout as measured to eye. Teeth in jaws all finely serrated along margins, and with very inconspicuous cusps, if present. Upper teeth all broad, and lower ones about half as wide. An evident pit at each corner of mouth, though no folds. Nostrils rather small, inferior on snout about half way in its length, and with but small flaps. Internasal space wide, about half of interorbital, and latter broadly, though rather evenly convex. Gill-openings 5, last 2 over base of pectoral, and third longest, about 3 in interorbital space. No spiracle. Body covered everywhere with minute shagreen denticles, not very rough to touch. Around superior edges of snout are many minute pores. Origin of first dorsal about opposite first $^2/_7$ in space between origins of pectoral and ventral, or much nearer tip of snout than origin of second dorsal, fin high, its apex just after its posterior basal

margin and its posterior point about 4 in interorbital space. Second dorsal small, its posterior margin nearly vertical or without posterior point, and its origin nearer posterior basal margin of first dorsal than end of last vertebra. Anal inserted a little nearer origin of lower caudal lobe than that of ventral, or about opposite first third in base of second dorsal, its lower margin deeply incised, and posterior point large or about 6 in interorbital space. Origin of upper caudal lobe begins a trifle in advance of lower, and its greatest width near tip, $6^2/_5$ in its length. Lower caudal lobe large and falcate, its length about $^3/_7$ in its base, and after anterior lobe width narrow to notch. Pectoral long, slender, falcate, reaching about opposite posterior basal margin of first dorsal, or about $^3/_5$ to ventral, and its greatest width nearly half its length. Ventral small, broad basally, its depth about $^4/_7$ its length, and origin of fin a little nearer posterior basal margin of first dorsal than origin of anal. No claspers. Color of dried skin dull or rather deep sandy-gray, becoming slightly paler on under surface of body, especially on lower surface of head and belly. Fins all more or less tinted like back, also upper surfaces of pectoral and ventral. Lower surfaces of these fins, perhaps a trifle pale. Teeth white. Length 8 feet 2¾ inches. No locality is given, but evidently, if memory serves correctly, this example came from off the New Jersey coast, probably near the mouth of Delaware Bay. I. A. Sweigart. It agrees largely with Le Sueur's figure, which I republished in the Report of 1906, especially in the rather long and slender falcate pectoral, which would reach to the posterior basal margin of the first dorsal at least. The second dorsal is shown somewhat differently, however, as it has a posterior point. The anal is also larger.

A large shark, evidently this species, was taken about 1887 at Lincoln Park on the Delaware River, according to Mr. R. W. Pierce. It was caught in a sturgeon-net and thought to be following the sturgeon. This record is of interest, as the water at the locality mentioned is tidal, and therefore only slightly brackish at the most.

One, evidently this species, reported to Mr. W. J. Fox on August 15th, 1905, at Sea Isle City. They were abundant on

September 10th, when about 10 were noted, ranging from 3 to 4 feet. These did not seem to be the next species.

About Cape May the large sharks usually reported as "man eaters" may probably be this species. They are described as sandy-gray in color, and chunky like a mackerel shark. Mr. H. Walker Hand says they have been noticed from off Hereford Inlet, inside Uncle Eph's Shoal and the Bare Hole Fishing Grounds. They are sometimes taken and found, after dissection, to be full of eels. Probably some of the large sharks reported to occur in Delaware Bay about Green Creek are also this species. They attain 6 feet in length.

Carcharhinus milberti (Müller and Henle).

Small White Shark.

Small, pale-colored and chunky sharks seen in the shallows at times, off Palermo, seldom measure over 3 or 4 feet, are reported by the fishermen. They have pale eyes and are most likely this species or the young of *Carcharhinus obscurus* (LeSueur). One taken by fishermen in Grassy Sound Inlet on September 4th, 1897. Mr. I. N. DeHaven secured another in Atlantic City Inlet on September 25th, 1897.

Family SPHYRNIDÆ.

(Cestraciontidæ.)

Sphyrna zygæna (Linnæus).

Hammer Head Shark.

One taken by Mr. Edwin Fowler, in Grassy Sound Inlet, on September 4th, 1897, on a weak-fish line. Rather small and savage when hauled on board. Mr. W. J. Fox reports one taken at Sea Isle City on August 15th, 1905, and one 3 feet long taken on September 10th at the same place. About Cape May, Mr. H. Walker Hand reports it from off Hereford Inlet, Five Fathom Bank, McCrie's Shoal, on or about Old or Uncle Eph's Shoals

and Bare Hole Fishing Grounds. They occur at Cape May Point, in Delaware Bay, about the Fishing Creek drum-beds, and as far up, at least, as Egg Island. They were also reported from over the Delaware breakwater.

Family SQUALIDÆ.

Squalus acanthias Linnæus.

Spiny Dog Shark.

Mr. W. J. Fox reported about 25 taken at Sea Isle City on April 29th, 1906. About Cape May, Mr. H. Walker Hand reports it from off Hereford Inlet, Five Fathom Bank and on or about Old Eph's Shoal. The example described in Rep. N. J. State Mus., 1905 (1906), p. 67, was one of a pair taken on McCrie's Shoal.

Family RAJIDÆ.

Raja erinacea Mitchill.

Hedge Hog Skate.

Color of adult breeding female in life more or less warm brown, surface of back more deep or rich brown than around edges of disk, where somewhat translucent, and this latter especially on each side of snout. Back with rather obscure mottlings of dusky-brown, most distinct down each side in middle of disk. Iris white below, becoming golden-brown above, and with a narrow golden circle around pupil, though above curtained with several golden-brown points. Spiracles whitish inside. Dorsals brownish, like back. Thorns all grayish to horn color. Lower surface of body milky-white and margin of disk translucent, especially on each side of snout. Length about 15 inches. A few of these small skates were seen at Green Creek on May 5th, 1907, the male, as usual, less spiny than the female and with very long claspers. The above-noted female contained ripe ovaries. They were not so abundant as the next species.

Raja ocellata (Mitchill).

Big Spotted Skate.

Head 3¼ in body, measured from tip of snout to base of ventral behind; snout 1½ in head; eye 7; width of mouth 2; internasal space 2⅓; bony interorbital region 2⅔; interspiracle region $2^{1}/_{10}$; space between anterior pair of gill-openings $1^{1}/_{10}$; space between posterior pair of gill-openings 1⅝; space between origins of ventrals $1^{3}/_{7}$; greatest width of ventral, to end of anterior lobe, 1½; base of first dorsal $2^{4}/_{7}$; base of second dorsal 2½; length of disk from tip of snout to tips of anterior ventral lobes less than its width by space equal to that from tip of snout to front of mouth; tail measured from point opposite posterior basal edges of ventrals, a little less than length of disk, or for a space about equal to half of snout. Disk very broad. Head well depressed. Snout firm, tip but little flexible and median fontanel level. Eye near last third in length of head, elongate and depressed above. Canthus well depressed. Mouth transverse below, dental edge well convex, or slightly double convex. Teeth about 60 series in upper jaw. Lips thin, upper scarcely free and only edges of posterior flaps fringed. Nostrils large, just outside exposed width of mouth, sending back a groove to corner of mouth and curving posteriorly towards its fellow behind this. Interorbital space broad, depressed concavely and more or less flattened medianly. Gill-openings rather small. Spiracles broad, their width about ⅔ of eye. Body very roughened, with rather large posteriorly-directed thorns above, especially submarginally on disk. On anterior part of disk they are much smaller, and reach their greatest development on posterior lobe. All along anterior lateral margin of disk a narrow band of minute asperities. Tip of snout and each ramus of nostrils and supraorbital ridges covered with rather large thorny tubercles. A median series of minute thorns begins just after spiracles and persists till opposite origins of ventrals, after which entire median upper surface of tail is smooth on longitudinal depression to origin of first dorsal. Beginning on back anteriorly, and shortly after

median series, are 2 rather regular series of small thorns, similar. On each side of tail above they resolve into several irregular longitudinal series of thorns, becoming much larger posteriorly. Towards tip of tail they gradually become obsolete. Upper submarginal surface of ventral roughened. Entire lower surface of body smooth. No claspers. Dorsals 2, at end of tail and of about equal size. Pectoral with anterior edge convex, then concave and finally convex, and entire posterior margin broadly convex. Ventral elongate, anteriorly with a short lobe and posteriorly rather pointed. Vent large and well behind origins of ventral fins. Color in alcohol more or less uniform brownish above. Below dull whitish. Length 32 inches. This example, an adult female, with ripe ovary, was taken in a pound at Green Creek, in Cape May county, May 5th, 1907. H. Walker Hand and H. W. Fowler.

Color of the above in life above dull muddy-brown, back and entire upper surface of disk all more or less of uniform tint and finely marked with dusky spots. These spots, nearly blackish, indistinctly defined and none so large as eye, many about size of pupil, or even smaller. Spots on tail becoming inconspicuous distally, or when extending about basal $\frac{2}{5}$ of its length, outer $\frac{3}{5}$ unicolor. Dorsal fins brownish, like back. As viewed above edge along tail distally is grayish-white. Iris with upper half muddy-brown, nearly as deep in tint as back, and lower half dirty or soiled-white. Around pupil a very narrow circle of golden. Curtain over pupil fringed brownish, like back. Lower surface of body milky-white. On each side of snout and along edges of pectoral translucent grayish spots.

It is the most abundant skate along the bay shore, and is taken in all the pounds we visited at Green Creek and nearly to Fishing Creek. Most all we saw were adults and seemed to display but little variation, except in the sexes, the males, as a rule, being less spiny or thorny than the females. All measure about 3 feet in length, and in this respect the sexes do not vary. The claspers of the male are long, like those of the preceding species. These skates are taken in the pounds and then hauled up on shore to be used as fertilizers. Most we saw were thrown up on the shore close by the king crab pens. Some farmers take them

back and spread them over the fields to manure their soil. Such places were very foul-smelling, on account of the desiccating bodies. We noticed, besides all the skates mentioned, herring, mossbunkers and flounders. The waste of the latter, especially, was deplorable, as in a number of cases large examples of the summer flounder of about 2 feet in length were found rotting along with the others. Several herring were sometimes used to a hill to force the corn. The buzzards and crows have plenty of food in such places, and along the beach, where there is always a great variety of rotting animal life, insects also abound in profusion. A number of large examples of both sexes of this skate were seen along the bay shore at Green Creek, June 9th, 1907.

Raja eglanteria Lacépède.

Common Speckled Skate.

A single example, about 28 inches long, was seen among the other skates at Green Creek, Cape May county, May 5th, 1907. H. Walker Hand and H. W. Fowler. Mr. Hand says they prefer sandy bottoms, with croakers and sea robins, and for this reason may be unusual in Delaware Bay. Sometimes reported from the pounds in June. Reported at Barnegat Pier on July 30th, 1907.

Egg cases, most likely belonging to this species, were found on the beach at Ocean City Point on August 16th, 1907. This skate was reported to be the most abundant species at Beesley's Point, Somers Point and Ocean City, and in Great Egg Harbor Bay during the past summer.

Family DASYATIDÆ.

(*Dasybatidæ.*)

Dasyatis centroura (Mitchill).

Sting Ray.

During the past summer sting rays have been very scarce in the bay along the Cape May county shore, and but few have been

taken. Probably the present species is the most abundant. The protracted cold of last spring is suggested as explaining their scarcity, as they seldom appear at all, unless the water warms. They range along this region from Cape May Point, at least, to Goshen Creek. Throughout this extent large ones are taken in the pounds. At the mouth of Dennis Creek, several years ago, during a single haul of a 25-fathom seine about 39 were taken. The large examples are said to measure about 5 feet across the disk.

The sting rays reported in Great Egg Harbor Bay about Beesley's Point, Somers Point and Ocean City are probably this species.

Dasyatis say (Le Sueur).

Say's Sting Ray.

Disk rounded. Tip of snout rather truncated. Eyes oblique, rather small. Body smooth. Tail rather smooth, with a wing-like expansion above and below, latter larger and nearly a third broader. Tail a little longer than body, thicker at base and tapering to an acute point. Two spines placed nearer base of tail than at its tip, and upper larger. Fins and tail thick and broadest or deepest medianly. Upper fin on tail begins near tip of spine and lower arises near its base. Ventrals rounded and short. Color, when fresh dull brown above, below gray-white. Fins on tail dusky. Entire length about 44 inches. Found at the pounds at Green Creek, in Cape May county, June 9th, 1907. B. W. Griffiths, T. D. Keim and H. W. Fowler.

The above was the only example seen and was undoubtedly this species. It was in poor preservation and nearly decomposed, and therefore not preserved.

Family MYLIOBATIDÆ.

Rhinoptera bonasus (Mitchill).

Cow Nosed Ray.

The large rays, so destructive at times to clams and oysters, in Delaware Bay off Green and Fishing Creeks, are probably this species. They seem to be less frequently captured than *Dasyatis*.

Family ACIPENSERIDÆ.

Acipenser sturio (Linnæus).

Common Sturgeon.

Color of young when fresh deep sandy-gray above, darkest on back, paler on side below, and lower surface milky-white almost entirely. Entire under surface of head extending up till level with lower edge of eye, milky-white. Shields on back and side all horny-gray in color, those along lower edge of body horny-white. Iris slaty with pale circle around whitish pupil. Dorsal deep dusky-gray, edges of fin narrowly in front, and broadly above and behind, white. Caudal similar, only lower surface of caudal peduncle milky-white. Anal largely milky-white with a median blotch of dusky-gray. Spine and front edges of pectoral gray to milky-white, and fin otherwise deep dusky-gray, especially dark distally. Ventral similar to anal, only paler inside. Length 9¾ inches. Found in the Delaware River at Washington Park, Gloucester county, May 4th, 1907. Charles H. Conner.

A mouche about 2 feet long was picked up on the bay shore at Green Creek on June 9th, 1907.

During the past season sturgeon fishing has been very poor, according to accounts at Pennsville, some fishermen not making expenses, and others have stopped operations.

Mr. J. B. Vanderveer believes that the sturgeon sleeps, as he has on one occasion at least found it floating on its back in an eddy formed by a rock in the Delaware at Trenton. This example was 6 or 7 feet long and was harpooned.

Acipenser brevirostrum Le Sueur.

Short Nosed Sturgeon.

Head 4¾, to last lateral shield; depth 6; width of head $1^4/_7$ in its length; depth of head at origin of first occipital buckler 1¾; snout $2^4/_7$; eye 10; width of mouth, measured inside, 4; interorbital space $2^2/_7$; internasal space 4; length of dorsal measured

along its anterior lobe 1⅘; length of anal measured along its anterior lobe 1⅘; least depth of caudal peduncle 5; length of lower caudal lobe measured along its lower margin 1¼; pectoral $1^{2}/_{7}$; ventral 2; head 1¼ in upper caudal lobe. Body long, slender, rather cylindrical anteriorly, and becoming compressed posteriorly, greatest depth about midway in length of entire predorsal region, and profiles similar. Caudal peduncle small, a little compressed laterally, and its least depth 2¼ in its length measured posteriorly to last lateral scute. Head large, broad, depressed especially anteriorly, posteriorly above broadly convex, sides rather steep, and entire under surface depressed or flattened. Upper profiles of head rather evenly convex from tip of snout to occiput, but lower less inclined. Snout very broad, convex, depressed medianly, and as viewed above, rather narrowly convergent, and its length about ⅘ its width. Eye small, a little ellipsoid, high, and placed about first $^{3}/_{7}$ in length of head. Mouth large, broadly transverse below, and its front margin falling about opposite middle of eye. Lips rather thick and little free. Edges of jaws rather obtuse. Tongue large, thick, fleshy, and apparently not free. On under surface of snout midway in its length as measured to front of mouth, 4 slender barbels, subequal or about equal to half of width of mouth. Nostrils large, close together before eye, anterior smaller, a little superior and near last $^{2}/_{7}$ in length of snout, and posterior a crescent just below margin of eye well anterior. Interorbital space elevated convexly, and depressed medianly where it is level, this level surface also extending nearly to tip of snout. Opercle large. Gill-openings large, only continued forward for about last eighth of length of head. Gill-rakers 17 short compressed cuneate firm points, largest about 3 in horizontal diameter of eye. Gill-filaments long, longest about 2⅕ in interorbital space. Pseudobranchiæ about ¾ of eye-diameter horizontally, and extending as a narrow submarginal arc all around under surface of gill-opening. Isthmus broad, depressed, and its least width $2^{2}/_{7}$ in interorbital space. Skin and bony surfaces where exposed all finely rugose, especially most all of head. On opercle rugose surface forms radiating striæ. A dorsal series of bony bucklers, all rugosely striate, with a median longitudinal keel

and posterior ones ending in a small recurved thorn extending from occiput to dorsal. They are 11 in number. Alongside from gill-opening above to middle of base of tail a series of 23 smaller and more conspicuously keeled similar bucklers. On costal region they are larger but become crowded and smaller along side of caudal peduncle. Their course is that of a median lateral line. From below base of pectoral a series of rather less conspicuous bucklers, though similar to dorsal ones, extend to origin of ventral. They are 9 in number, and though keeled, are without spines. On each side of vent a small buckler, and following are 2 large ones, though all these not keeled but flattened and inconspicuous. Skin everywhere with minute spinules, rough to touch, and in very many series. They are a little coarser and more numerous on ventral region and lower sides. Origin of dorsal a trifle before last third of entire length of fish, anteromedian rays highest and forming a pointed though rather blunt lobe, so that greatest height of fin is 4/5 of its base. Origin of anal opposite middle of base of dorsal, base of fin about 1½ in its height, anteromedian rays highest, and tip of depressed fin reaching origin of lower caudal lobe. Caudal with upper lobe long, slenderly acuminate, its origin about opposite that of lower lobe, and with bony radii along anterior margin at first greatly developed but gradually becoming small towards tip. Lower caudal lobe broad and pointed. Pectoral rather large, broad, uppermost rays longest and upper branched ray strongly osseous, especially basally. Pectoral reaches but 3/8 of space to ventral. Ventral inserted opposite posterior portion of eighth dorsal buckler, and when depressed its tip a little before origin of dorsal. None of ventral rays especially osseous. Vent about first fourth of postventral region. Color when freshly dried deep slaty over general upper regions, bucklers all paler or dull olive-gray. Entire upper surface of head dull olive. Lower surface of body dull brownish-white. Fins all dusky-brown, usually with paler shades marginally. Iris faded slaty. Length 20½ inches. Picked up on the bay shore of Green Creek in Cape May county, May 5th, 1907. H. Walker Hand and H. W. Fowler.

The figure reproduced in Rep. N. J. State Mus., 1906, p. 86. is that of an adult, or probably old male, example of the common sturgeon (*Acipenser sturio*).

Dr. Kendall writes, "we had a number of this species from the Delaware (Gloucester, N. J.) under the name of 'mamoose.' Those specimens are in the U. S. Nat. Mus., I think. They were not recognized by the fishermen and even some ichthyologists were puzzled, but they were undoubtedly *brevirostrum*."

Family CLUPEIDÆ.

Pomolobus mediocris (Mitchill).

Hickory Shad.

Reported to occur in the tide-water of Cedar Swamp Creek near Petersburg. They are also reported to ascend the Tuckahoe River with the alewife. Mr. H. Walker Hand says it has been taken at Higbee's Beach on the bay shore of Cape May county.

Reported common in Great Egg Harbor Bay, according to the fishermen at Beesley's Point, Somers Point, and Ocean City, who know it as "hickory shad."

Pomolobus pseudoharengus (Wilson).

Alewife.

According to Mr. Hand it occurs all along the bay shore from Cape May Point to Dennis Creek in the pounds. They also occur in the Tuckahoe and Middle Rivers. They are the first fish to appear in the spring, coming with the rock, summer flounders and shad. Very abundant in the pounds about Green Creek on May 5th, 1907, and many were found gilled. About the fields we found them abundantly strewn with other fish as fertilizers. None were over 12 inches long. When remaining in the water any length of time after death their backs become more or less dull slaty-blackish.

Mr. B. W. Griffiths says they ascend the tide-water of the south branch of Timber Creek to Blackwood, in Camden county. Hundreds were taken there in the spring of 1900, when there was a great run. Several were seen along the bay shore at Green Creek on June 9th, 1907, and again on June 23d. Mr. H. Walker Hand reports herring as biting readily on shrimp late in July of 1907, about Cape May.

In Great Egg Harbor Bay it was reported very abundant, during last spring, about Somers Point, in the Great Egg Harbor River, Ocean City, Beesley's Point, and in the Tuckahoe River as far as Tuckahoe. It is known as "herring."

According to Mr. J. B. Vanderveer, of Trenton, the fishermen would formerly stop the herring in their ascension during the spring so that many would happen to spawn there. This was due to so many examples congregating in places where there were obstructions, and then they were taken by thousands. Persistent muddy water also seemed to check them so that they frequently spawned in great numbers between Trenton and Bordentown. Mr. Vanderveer says the "alewife" generally appears 2 or 3 weeks earlier than the so-called "rail herrin."

Mr. B. W. Griffiths has seen them in the spring in Mantua Creek as far as Wenonah, Gloucester county.

Pomolobus æstivalis (Mitchill).

Black Bellied Herring. Black Belly. Rail Herrin. Real Herring.

Mr. J. B. Vanderveer reports that a herring, with a distinctly black peritoneum, ascends the Delaware tide-water as far as Trenton, where he has captured many hundreds of them. They appear later than the alewife and spawn nearer shore, the latter, more like the shad, preferring deeper water. He describes them as more slender and slightly differing in color from the alewife. I reject Dr. Bean's contention of Storer's name *Alosa cyanonoton* for this species, as the latter's description and figure are both that of the alewife, he evidently having confused this species, but not described it under that name. This view is suggested by Dr. Kendall.

Alosa sapidissima (Wilson).

Shad.

Reported to have been seen occasionally in the tide-water of Cedar Swamp Creek near Petersburg. Usually every spring a few are taken in the pounds at Green Creek in Cape May county. They occur in the pounds from Cape May Point to Dennis Creek, at least, but few are taken at a time, usually 4 or 5. They have been brought in at Higbee's Beach, Fishing, Green and Dias Creeks, according to Mr. Hand. Several were taken late in May and early June of 1907, in the pounds at Green Creek.

Shad fishing at Pennsville, in Salem county, during the past season has been reported prosperous, some fishermen having claimed as much as $800.00 for their catch, and the same is said for others at various river towns. The number of fish has not been remarkable. The lowest price received this season was $19.00 per hundred, and the highest $60.00, with an average of about $40.00. The fishermen estimate from 1,500 to 3,000 caught by each individual.

In Great Egg Harbor Bay it was rather scarce during the past season. It was noted at Beesley's Point and the Tuckahoe River in its lower tide-water, also Somers Point and the lower Great Egg Harbor River, and apparently not ascending as far as herring.

Mr. J. B. Vanderveer reports that the largest shad under his observation taken in the Delaware, a little above Trenton, weighed 13 pounds, 2 ounces. He also notices that in the spring run all examined contained food in their stomachs. When spent the shad, like the chub, was found to be weak. They would drift down with the tide, and sometimes when they would be carried into an incoming tide at Trenton and not having strength to resist it, though with the impulse, would die. They were then found sometimes in numbers. At times fungus diseases would break out, though equally rare at others.

Brevoortia tyrannus (Latrobe).

Mossbunker.

Reported in the tide-water of Cedar Swamp Creek near Petersburg. This is the "bony fish" of Delaware Bay, where it is distributed all along the shore from Cape May Point north. It also occurs all over the sound, where, like in the bay, they are to be found in rather small schools. About Green Creek the "bony fish" was abundant with the alewives on May 5th, 1907. All seen were adults. H. Walker Hand and H. W. Fowler. Many in the pounds on June 9th, 1907, and on June 23d.

Family SALMONIDÆ.

Salmo salar Linnæus.

Salmon.

One was caught in a pound at Holly Beach. About 8 or 10 years ago one was taken in Delaware Bay at Green Creek, Cape May county, by Mr. E. Cresse. Mr. H. Walker Hand furnishes these reports. Dr. W. C. Kendall reports one taken at Bayside. It is $9^{3}/_{16}$ inches, a smolt, with red spots, and caught in salt water. It was sent to the U. S. F. Com. by Mr. Eugene Blackford.

Family AGUILLIDÆ.

Anguilla chrisypa Rafinesque.

Eel.

Small ones were taken in the tide-water of Cedar Swamp Creek at Petersburg, April 16th, 1907, by T. D. Keim and H. W. Fowler.

Found larval young abundant in the debris along the Pensauken Creek near Pensauken, in Burlington county, April 28th, 1907.

Mr. H. Walker Hand says they occur from Mad Horse Creek to Dias Creek, in Cape May county. In the season of 1905 and 1906 about 6½ tons, one man's catch, were taken by Howell Bros. This season they were scarce in comparison, only about 2,300 pounds having been taken. A large eel taken at the Cape May Point sewer opening was upwards of 3 feet in length.

Along the bay shore of Cape May county the eel reaches upwards of about 4 feet and a weight of 10 pounds, and is frequently larger. Small or young examples were found at the mouth of Fishing Creek on May 5th, 1907. A small one found on the beach at Green Creek on June 9th, 1907.

Reported to occur in the south branch of Timber Creek at Grenloch, Camden county. Mr. O. H. Brown reports an example taken at Higbee's Beach some years ago, which was olive in color with rather pronounced longitudinal stripes. At Green Creek, on June 23d, eels were common, and many dead ones were washed ashore. A method sometimes in vogue for their capture is to sink a dead king crab in the sand, and in a short time, as the small eels appear to feed, they may be thrown into a pan by hand. Reported to be abundant at times about Beesley's Point and Somers Point. Reported from Lake Hopatcong by S. H. Hamilton.

Several small ones found in New England Creek, tributary of Delaware Bay at Higbee's Beach in Cape May county, on October 6th, 1907. Found in Teal's Branch of Pond Creek, at Higbee's Beach, on October 15th, 1907.

Family CYPRINIDÆ.

Semotilus bullaris (Rafinesque).

Chub.

One was taken in the south branch of Big Timber Creek, near Turnersville, Gloucester county, on May 19th, 1907. It was about 8 inches long, more or less silvery in life, without tubercles, and shoulder-girdle with leaden-bluish reflections.

Mr. J. B. Vanderveer says that he has found chub in the Delaware at Trenton of 3 to 4 pounds in weight. He thinks that the

true minnows are not so abundant now as formerly, when the water was clear and not polluted, and also believes that to the same cause may be traced the scarcity of large white perch. He thinks the toothed minnows (*Pœciliidæ*), however, have not been affected by the change.

Abramis crysoleucas (Mitchill).

Roach.

A number of young were taken in Kinkora Creek, near Kinkora, Burlington county, on October 15th, 1906, by Mr. T. D. Keim and myself.

On May 5th Mr. H. Walker Hand and myself took a small example in the fresh-water of Fishing Creek, where it flows over the beach, with *Fundulus* and *Cyprinodon*. Several small examples were taken later in the same outlet at Ross's mill pond. Owing to the very dark water they were even darker than those in Dennis Creek last year. The black lateral band was conspicuous along the side, and their bodies were reflected with the deepest of metallic blue-green or steel-green. Mr. H. Walker Hand has taken large or adult examples in Ross's mill pond, tributary to Fishing Creek.

Young were abundant in the quiet shallows of the pond at Turnersville tributary to south branch of Big Timber Creek, Gloucester county, on May 19th, 1907. In most all such places they were found associated with *Notropis chalybæus*. They were not dark, like those from Dennis and Fishing Creeks, in Cape May county, but resembled those from Pennsylvania waters with their paler blue or green lateral reflections. Several large ones in the rapid water were probably this species.

Found in the pond at Clementon, basin of north branch of Big Timber Creek, in Camden county, on October 20th, 1907. They are used for bass-bait by the fishermen, and kept in rather large live-cans which are submerged. The usual size is half-grown.

Notropis bifrenatus (Cope).

Bridled Minnow.

Several nearly adult examples in the Pensauken Creek, near Merchantville, Burlington county, on January 7th, 1906.

In a cut-off, tributary of Saddle Creek, in the Passaic basin of Bergen county, near Ridgewood, I found these little minnows very abundant on July 1st, 1901, when very many adult examples were secured.

Found in Edward's Run, tributary of Mantua Creek, Gloucester county, November 3d, 1907, by B. W. Griffiths and H. W. Fowler.

Notropis procne (Cope).

Swallow Minnow.

Head 4; depth 4⅛; D. III, 7, 1; A. III, 6, 1; P. 1, 10; V. 1, 7; scales 32 in lateral line to base of caudal and 2 more on latter; 5 scales obliquely back from origin of dorsal to lateral line; 4 scales obliquely up and forward from origin or anal to lateral line; 12 scales before dorsal; width of head 1⅞ in its length; depth of head at occiput 1⅓; snout 3¼; eye 3¼; maxillary 3; interorbital space 2⅔; first branched dorsal ray about $1^{1}/_{15}$; first branched anal ray $1^{2}/_{7}$; least depth of caudal peduncle 2¼; pectoral 1⅛; ventral $1^{1}/_{6}$; upper caudal lobe 3½. Body elongated, compressed, rather slender, profiles similarly convex, greatest depth at origin of dorsal, and edges of body rounded. Caudal peduncle rather slender, compressed, and its least depth about half of its length. Head small, compressed with flattened sides slightly converging below, and upper profile a little more abruptly inclined than lower. Muzzle obtuse. Snout short, convex both over surface and in profile, and its length about ⅘ its width. Eye moderately large, high, a trifle longer than deep, and its center falling about first $^{3}/_{7}$ in length of head. Mouth inferiorly terminal, moderate, but little inclined, and when closed upper jaw slightly projecting. Premaxillary protractile down-

wards. Maxillary but little inclined, and reaching posteriorly opposite front margin of eye. Edges of jaw firm and a little trenchant. Lips rather thin and little developed. Mandible shallow, and rami a little elevated inside mouth. Tongue thick, fleshy, adnate and rather far back. Nostrils together on upper side of snout near upper front of eye, posterior larger and exposed in form of crescent. Interorbital space broad, but little elevated convexly, and greatly depressed. Preorbital large, and its greatest width about $^5/_7$ in its length, which latter is 1½ in eye horizontally. Other suborbitals all narrow. Posterior margin of preopercle nearly straight and inclines a little forward. Gill-openings extending forward opposite posterior margin of pupil, and width of isthmus at that point about ⅓ of eye horizontally. Gill-rakers about 2+5 short weak points, each much less than length of gill-filaments. Gill-filaments about $^4/_7$ of orbit. Pseudobranchiæ large, a little less than gill-filaments in length. Pharyngeal teeth 4–4, hooked a little at tips, and each one with a slight grinding-surface. Surface of isthmus depressed. Scales moderately large, or about uniform size except on breast and base of caudal where a little smaller, disposed in longitudinal series parallel with lateral line, and each one with a number of fine radiating striæ. Lateral line complete, decurved a little anteriorly, and ascending middle of side of caudal peduncle. Origin of dorsal midway between tip of snout and base of caudal, graduated down from first branched ray which is longest, and depressed fin reaching about $^5/_{11}$ to base of caudal. Origin of anal inserted a little behind base of last dorsal ray, graduated down from first branched ray, and depressed fin reaching about $^6/_{11}$ to base of caudal. Caudal rather long, slender, deeply forked, and with long pointed equal lobes. Pectoral reaches ¾ to origin of ventral, pointed, and upper rays longest. Ventral inserted opposite origin of dorsal, and when depressed reaching origin of anal. Vent close in front of anal. Color in alcohol plain pale or light brownish generally, upper surface of body scarcely darker. On back above edge of each scale dusky. A dusky line down middle of back. Upper surface of head dusky, sides silvery and lower surface whitish. Iris pale slaty. A dusky streak from tip of snout back along side of head almost to

base of caudal, being separated from latter only by a narrow pale space. On trunk lilac and bluish reflections. At base of each scale at beginning of each tube in lateral line a deep dusky or blackish spot. Dorsal and caudal dull grayish, former with dusky tinge at bases of posterior rays, and latter with a black spot about size of pupil at bases of median caudal rays. Other fins all transparent whitish, upper edge of pectoral a little grayish. Length, $1^{13}/_{16}$ inches. Delaware basin in Mantua Creek at Mantua, Gloucester county, April 8th, 1906. S. H. Hamilton and H. W. Fowler. The above is the only New Jersey example I have seen.

Notropis hudsonius amarus (Girard).

Gudgeon.

I have examples from Haddonfield, taken by E. D. Cope many years ago.

Notropis analostanus (Girard).

Silver Fin.

A number, mostly small, were taken in the Pensauken Creek, near Merchantville, January 7th, 1906.

Color in life above dilute brownish with an olive tint. Edge of each scale on back dusky, and as they ascend to median dorsal region becoming more profusely pronounced dusky along edges, and in fact this extending well over each scale of median dorsal line. Below body silvered whitish, though under surface of caudal peduncle becoming translucent. Peritoneum showing through body-walls as bright white. An underlaid silvery band extends from eye to base of caudal, and very distinct in some lights. Iris silvery-white. Caudal slightly tinged with ruddy. Dorsal pale or somewhat translucent whitish, with white satiny distally, rather slightly developed, and traces of dusky midway on posterior rays. Other fins translucent. After death sides of body with greenish and golden reflections. Described from an adult taken in Chestnut Branch of Mantua Creek, near Sewell,

Gloucester county, on April 1st, 1906. These fishes were only found in the running water near or about the sand bars where comparatively shallow, or in places where there were pebbles and small stones. In habit they were rather quiet as a rule, or not very active. As seen in the water they appear similar to those found so commonly in the Pennsylvania tributaries of the Delaware. None were found in the deep pools. The larger examples showed the satiny-white pigment but little developed on the dorsal and anal fins, and a few small ones also had it developed a little, though comparatively much less distinct. They did not appear to be spawning. All exhibited the lateral silvery band from orbit to caudal rather conspicuously.

Those taken near Mantua, on April 8th, 1906, had the caudal slightly ruddy in life, and the edges of the scales slightly dusky. Sides with a sheen of greenish. Iris silvery.

Found in Kinkora Creek, near Kinkora, Burlington county, on October 15th, 1906.

Notropis cornutus (Mitchill).

Red Fin.

Found young in Edward's Run, tributary of Mantua Creek, in Gloucester county, on November 3d, 1907. B. W. Griffiths and H. W. Fowler.

Notropis chalybæus (Cope).

Blue Green Minnow.

Abundant, both adults and fry, in the Pensauken Creek, near Merchantville and Pensauken, Burlington county, January 7th, 1906. They were all pale and like the typical Delaware River type. Also on April 28th, 1907, when small schools were found about the shallows. The individuals were all of small size, or barely 1½ inches in length. No examples highly pigmented. They apparently form food for the numerous small pike which would dart out and among them.

In the south branch of Big Timber Creek, in the pond at Turnersville, Gloucester county, this was found to be the most abundant species May 19th, 1907. They were associated with *Abramis* and *Erimyzon*. Schools of rather large size could be found most anywhere in the still shallows, moving slowly about or between water lilies. They are rather conspicuous in the water and swim but a short distance if disturbed by one sweeping a dip-net among them. At times if the water was rather deep they would all swim back into the disturbed area, especially if muddy, and then the whole school could be captured by a single rapid sweep. Their object in this is very likely due to the concealment afforded by the churned up mud and sand of the bottom. They are all pale in color, like Bristol and Kinkora examples, and many had a decidedly brassy or yellowish tinge in life.

Notropis chalybæus abbotti Fowler.

Abbott's Minnow.

Color of adult in life brilliant deep metallic-brown on back and upper surface of body. Scales on back above all dusky-edged, so that a rather narrow pale longitudinal area is formed next to dark lateral band immediately above, by absence of dark edges to these scales. From tip of snout, including tip of mandible, preorbital, then passing through iris back over opercle and finally back to base of caudal, a brilliant steel-blue-green to blackish lateral band. It is sprinkled with dusky pigment-specks more or less throughout its course. Over opercle are beautiful coppery and purplish tints in course of dark lateral band. Just above latter around edge of snout a pale tinge. Iris silvery-white with a greenish tinge above, lower surface whitish generally. Lower surface of body silvery-white, translucent on lower surface of caudal peduncle. Dorsal ochraceous-dusky. Caudal same, only with a more orange tinge. Other fins transparent whitish. A narrow streak of dusky along base of anal, and along lower surface of caudal peduncle to origin of lower caudal lobe. Median rays of caudal fin not darker than others, and upper margin of pectoral slightly dusky. Length 2 inches.

Taken in the Rancocas Creek above New Lisbon, Burlington county, May 12th, 1907. They were rather abundant in the shallows where the water was more or less still and always warmer than in the deeper courses of the creek. The cut-offs and small bays, or coves, afford excellent places. If one should move about in such situations in a small boat he would not fail to find small schools of this fish. When in the water they move usually in concert about the little passages formed by the aquatic vegetation. As seen from above, they appear quite inconspicuous in the dark-stained water, only the dark and supralateral pale streaks being at all noticeable. They are apparently more disturbed by motions or movements, for while we remained still they would swim rather slowly and lazily about. They seemed to associate entirely with young *Erimyzon*. In coloration and habits they agreed entirely with those described from May's Landing.

Mr. Henry Warrington secured it in the Rancocas Creek, near Medford, Burlington county, in January of 1899.

Rhinichthys atronasus (Mitchill).

Black-Nosed Dace.

Abundant in a small tributary of the Delaware at Trenton Junction, Mercer county, October 10th, 1906. None had orange-colored fins.

Cyprinus carpio Linnæus.

Carp.

This has been introduced into Lily Lake at Cape May Point.

Family CATOSTOMIDÆ.

Erimyzon sucetta oblongus (Mitchill).

Chub Sucker.

Mr. H. Walker Hand has taken suckers in Ross's mill pond, tributary of Fishing Creek in Cape May county. Several have

been taken in brackish water, weighing from 1½ to 2 pounds, at the Dennis Creek Landing.

On March 10th, 1906, I took a small example in the *vittatus* stage in a small tributary of the Pensauken Creek, near Pensauken, Burlington county.

On July 15th, 1906, several young examples were taken in a tributary of Crosswicks Creek, near Trenton. They were paler than those taken in the Great Egg Harbor River.

Color in life of adult breeding male dull olive on back and creamy-white below with coppery reflections. From eye back alongside an underlaid band of rather deep dusky-olive, like general color of back above, and from which it is separated by an equally wide, paler interspace, though this not so pale as lower side or belly. Along back another on each side from head similar to lower dark mediolateral one, and not well defined above from general color of back. Below, or along its lower margin, it forms striking contrast with pale area. Color of back all overshot with purplish and coppery reflections in most lights. On upper side of body about 8 underlaid transverse shades as so many transverse bands, rather broad, and not quite so well defined as 2 longitudinal bands, but persisting below lower of latter, where they soon fade out in pale color of lower surface of body. Head adipose-like over most all its upper surface, especially above where it is more or less tinted with muddy-brown. Sides of head and under surface with similar adipose-like development, especially cheek, and with dull rosy and purplish tints. Opercle above with a slight greenish tinge. Lips pale or almost colorless brownish. Iris olivaceous, with dusky shades, and becoming greenish and bluish about narrow bright rosy circle around pupil. Dorsal transparent olivaceous on greater basal portion of fin, and between each ray a broad dusky blotch parallel, though this fading out towards margin. Caudal transparent olive, lower margin grayish, and submarginally a narrow dusky obsolete line. Anal with rays adipose-like, usually first or simple ones, and all others greatly tuberculate. First 4 branched rays much longer than others, broadly branched, and with very numerous small tubercles. On these rays medianly are about 4 or more large tubercles, similar to those on remain-

ing rays, only latter are without small outer ones. Anal membranes transparent slaty-gray. Pectoral translucent, base becoming dull orange and above largely dusky, also outer margin. Upper margin of pectoral adipose-like, becoming dark on distal portion. Ventral similar in color, only inner margin paler. In preorbital region 3 large laterally-directed tubercles. Lower lateral surface of caudal peduncle and posterosupraanal region with a narrow, roughened or slightly tubercular area, largely due to corrugated edges of scales. This extends back to caudal fin. Tubercles all pale brownish. Length 7 inches. This example taken in a clear stream of running water in woodland, a tributary of the Pensauken Creek near Pensauken, Burlington county, April 28th, 1907. C. J. Hunt and H. W. Fowler.

Color in life of a young example in the *vittatus* stage. Back dusky medianly, this forming into a black line anteriorly, which extends to eye, then along upper surface of snout to its tip, where it also joins its fellow, and this a narrow median streak of pale ground-color extends from upper surface of snout to dorsal, though broader on cranium. Ground-color of upper surface of body a ruddy terra-cotta tint. It occurs on each side of snout above dark lateral band. From tip of snout to base of caudal a jet-black lateral band, with a slight bluish tinge. Lower surface of body bright silvery-white. Dorsal dusky, with a warm tinge, or rather tinted with bright terra-cotta. Caudal deep reddish-terra-cotta color. Other fins transparent whitish. Lower surface of caudal peduncle translucent. Iris silvery-white, with a slightly ruddy tinge above. Length about 2 inches. Very abundant May 12th, 1907, in the Rancocas Creek above New Lisbon, in Burlington county. The warm color of the back is in agreement with the examples found in the Great Egg Harbor River, and appears different from that of those taken in the Delaware.

Young were very abundant in the pond at Turnersville, in the south branch of Big Timber Creek, in Gloucester county, May 19th, 1907. Though less abundant than *Notropis chalybæus*, they were more so than *Abramis*. They were pale, like Bristol and Trenton examples, not reddish on their backs, and have the dark

lateral band very distinct. Those we secured were a little larger than *N. chalybæus.*

Family SILURIDÆ.

Ameiurus catus (Linnæus).

White Cat Fish.

Small forked tailed cats, reported as "white cats," were said to occur in the larger pond at Dennisville, in Cape May county, on September 16th, 1906.

Mr. J. B. Vanderveer describes a cat fish as formerly, at least, very abundant in the Delaware about Trenton, where they would ascend in May to feed on the little oval shells, though appearing again late in the summer. They were called "silver tails." Sometimes schools would be found floating down stream, the fishes well inclined, with just the tips of their noses out of water and producing a constant bubbling, or sibilant noise, when quantities were captured by sweeping around them with nets.

Ameiurus natalis prosthistius (Cope).

Pine Barrens Cat Fish.

Small black cat-fish, with truncated tails were said to differ from the "yellow cat" and the "white cat" by the fishermen at Dennisville, in Cape May county. They occur in the larger pond and may possibly be this species. They are taken at night, or in the evening, with earth-worm bait, as they rarely take the hook during the day. During the week of September 19th, 1906, 3 were taken.

Ameiurus nebulosus (Le Sueur).

Yellow Cat Fish.

Mr. H. Walker Hand reports that cat fish occur in Green Creek Run, at White Reach in the head of Dias Creek and Ross's mill pond, tributary to Fishing Creek, Cape May county.

Those taken at White Reach were about a pound, or a little over, in weight. A small one was found at the mouth of Fishing Creek on May 5th, 1907.

Two dark examples taken in a pond near Pensauken, Burlington county, January 7th, 1906. They were about three inches long.

Color in life dusky-olive above, rather olivaceous on sides and becoming whitish below, with slight coppery tints. Under surface of head and belly whitish, with coppery reflections. Fins all dusky, also barbels. Iris whitish. Length 3¼ inches. A number were taken in the debris along the banks of the Pensauken Creek, near Pensauken, April 28th, 1907.

In the south branch of Big Timber Creek, near Grenloch, Camden county, on May 19th, 1907, several small cat fish were found associated with *Umbra* and *Enneacanthus* in a muddy puddle. They were slaty-brown above and pale whitish on lower surfaces of head and abdomen.

Mr. S. H. Hamilton says that in the "gob" of Hurd mine, at Hurdtown, in Morris county, there are reports of blind cat-fish. This hole is said to be over a mile in depth and is filled with dark water to its surface. The eyes are described as being inconspicuous and covered with thick skin. These fish are also taken by the foreign population and used as food. The largest seen were, perhaps, not over 10 inches. It may hardly be possible that they are really *Gronias?*

Small examples with black barbels were found in a pool near Sumner, on the north branch of Big Timber Creek, in Camden county, on October 20th, 1907. They were associated with *Umbra* and *Enneacanthus.*

Schilbeodes gyrinus (Mitchill).

Stone Cat Fish.

Color in life dull olive-brown, with slight leaden tint along edges of fins, although that of caudal becoming dusky-gray. Belly a little paler than sides and with coppery reflections. Barbels pale brownish. A dusky streak, or line of demarcation, sepa-

rates fins from trunk and another also marks lateral line. Fins transparent grayish or brownish. Iris slaty. Length 2 inches. Several small examples in the Pensauken Creek, near Pensauken, April 28th, 1907.

Family ESOCIDÆ.

Esox americanus (Gmelin).

Ditch Pike.

A number were taken in Crosswicks Creek, near Trenton on July 15th, 1906. The largest 10 inches long.

Examples reported about a foot in length from the larger pond at Dennisville, in Cape May county, on September 16th, 1906, were probably this species.

Color in life olivaceous above, with beautiful streaks of coppery, brassy and golden in some lights. Entire upper side of trunk and most of head posteriorly finely streaked, speckled or spotted with deep dusky-black. These streaks on side of trunk all have a tendency obliquely forward. A narrow black band from end of snout to eye and continued behind it to opercle above. Below, and from eye posteriorly, a black streak passing obliquely back behind end of maxillary to lower side of head posteriorly. Upper surface of head olive, speckled with dusky. Eye deep brown over iris, with vertical dusky or blackish band continued up through it. Lower surface of body milky-white, more or less opaque. Dorsal dilute olivaceous, margin narrowly dusky, rays darker and entire fin with a warm tint. Caudal similar and with a slight dusky edge, also with more orange tint on lower lobe. Lower margin of caudal somewhat milky-white or gray. Anal warm orange-red, other fins same, only ventral more vermilion. Length 8¾ inches. Pensauken Creek, near Pensauken, April 28th, 1907. Another example is darker on back and shows lines on sides sloping obliquely forward more continuous, broader and larger. Iris with a golden ring around pupil. In other respects as usal. These fish vary considerably, and of the number secured the first one noted presented a rather remarkable variation in color, especially in having the bands broken up into small spots.

About the shallows or banks these fish would be found, remaining perfectly motionless until disturbed, when they will dart away in a straight line for other quarters. Their course is evident, as they are usually resting about the shallows, and then dart out into deeper water. They struggle awhile when caught, as a rule, and then become quiet, or only move about for a few short intervals before expiring.

Esox reticulatus Le Sueur.

Pickerel.

About Dennisville, in Cape May county, it occurs in the large pond according to the fishermen. On several occasions examples were reported of large size, some as much as 6 pounds in weight, though such were regarded as very unusual.

Mr. B. W. Griffiths reports that large pike have been taken in the Pensauken Creek, near Pensauken, occasionally.

Color in life olivaceous above with dusky. From tip of snout to base of caudal an irregular streak of pale brownish-white with coppery or lavender tints in some lights. This streak broken more or less in places. From tip of snout to origin of dorsal over upper surface of body medianly a pale brownish streak. Lower surface of body white, more or less translucent. Sides of body with beautiful green reflections in some lights, very brilliant at times. Back more or less specked with dull dusky. Opercle with brilliant golden reflections. A dusky streak from tip of snout along its sides through eye and back on opercle. Another from lower margin of eye down over cheek. Mandible more or less translucent to grayish, becoming dusky towards tip. Iris tinted with greenish above and with a narrow golden ring around pupil. Dorsal and caudal dull brownish with a slightly warm tinge, and also somewhat grayish to dusky marginally. Other fins translucent whitish. Length about 5 inches. Taken in the Rancocas Creek above New Lisbon, Burlington county, on May 12th, 1907. Small pike were abundant about all the still shallows where concealment was afforded by the aquatic vegetation. They probably found an abundant supply of food in such places in the numerous small fishes. No examples over a foot in length were seen.

A small example was taken in the pond at Turnersville, south branch of Big Timber Creek, in Gloucester county, May 19th, 1907. Some of the small pike we saw may have been *E. americanus*, but the only young one secured was the present species. Fishermen report they reach a good size at times.

Mr. S. H. Hamilton says they are abundant in Lake Hopatcong.

A large example was seen taken in the mill pond in the north branch of Big Timber Creek at Clementon, in Camden county, on October 20th, 1907.

Color in life olivaceous above, becoming paler or dilute on side. About 13 obscure pairs of blackish saddles transversely over back where they are very obsolete along median line. On sides dark dusky-olive reticulations begin level with eye's upper margin, and continue below nearly to base of ventral. Above, lateral reticulations join dorsal saddles. A dark dusky or blackish bar down from eye across cheek. Upper surface of head with underlaid obscure dusky specks. Snout and end of mandible dilute olivaceous. Iris brownish-dusky, dusky bar below extending up, and a narrow circle of golden around pupil. Dorsal, caudal and anal olivaceous, former unicolor though very slightly dilute reddish towards upper margin. Caudal with very obscure dusky specks, and its lower edge pale, especially towards tip. Pectoral and ventral pale reddish-orange with a very slight dilute olive tint, and latter fin entirely paler. Anal still paler than ventral. Entire lower surface of head and body milky-white. Length 10½ inches. A number of large examples were found in the pools just below the dam of Big Timber Creek, near Sumner, in Camden county, on October 20th, 1907. They were all about the size of the example above, and some were quite pale as they swam about. They did not appear especially timid.

Family UMBRIDÆ.

Umbra pygmæa (De Kay).

Mud Minnow.

One taken in Crosswicks Creek, near Trenton, on July 15th, 1906. Small examples, almost uniform blackish over entire

upper surface of the body at least, were taken in the submerged sphagnum of the Rancocas Creek above New Lisbon, in Burlington county, on May 12th, 1907. Several brownish or rather pale examples were scooped out of a muddy pool in the south branch of Big Timber Creek, near Grenloch, in Camden county, on May 19th, 1907. Mr. Henry Warrington secured it in the Rancocas drainage on January 22d, 1899, near Friendship, Burlington county. Found in a pool in the north branch of Big Timber Creek, near Sumner, in Camden county, on October 20th, 1907. Both were rather pale in color.

Family PŒCILIIDÆ.

Fundulus majalis (Walbaum).

May Fish.

About Sea Isle City the fishermen call the females "rock fish," as the dark longitudinal lines suggest the striped bass. The males are thought by some fishermen to be a different species. Mr. McCadden and myself found them very abundant at Ocean City Point, at the entrance to Great Egg Harbor Bay. They were of medium size, both sexes in very high color, fins of the males pointed and satiny-white pigment predominating. A few were also found in the ocean surf August 16th, 1907. Common at Ocean City on August 19th, 1906, according to Mr. David McCadden.

On May 5th, 1907, small examples were found along the Delaware bay shore at the mouth of Fishing Creek.

Fundulus heteroclitus macrolepidotus (Walbaum).

Killifish.

About Sea Isle City on July 19th, 1906, Mr. W. J. Fox and myself found them not so abundant as the former, and in the same localities. Many had the distinctive breeding colors noted at Cape May. Called "dabbler" and "bull-head."

On May 5th, 1907, large schools of small examples were found in the brackish water at the mouth of Green Creek and also in the fresh water of the latter as it flowed over the beach at ebb-tide. Later on, June 9th they, or others, were also seen. A number were seen about brackish runs, coursing over the beach at intervals, on June 23d. The darker ones were probably spawning males in full breeding-dress.

Found very abundant along the shallows at Barnegat Pier on July 30th, 1907. The sexes were in high color, and the females evidently gravid.

About Ocean City Point they were equally abundant with the may fish on August 16th, 1907. They were not so brilliantly colored as early in the season, and occurred in large schools in the tide-pools, though not at all in the surf.

Very abundant in Pierce's pond at Higbee's Beach in Cape May county, on October 6th, 1907. They collect in great schools along the shallows in clear water, and are difficult to secure except by seining. Only a few were found in the streams. Rather abundant in the marshes about the boggy roots of the cat tails of Teal's Branch of Pond Creek, where the water is 3 or 4 inches deep. They associate with *F. diaphanus,* were mostly small in size, dull in color, and ripple the water greatly in their efforts to find concealment when disturbed. October 15th, 1907.

Fundulus diaphanus (Le Sueur).

Barred Killifish.

Taken at Sea Isle City on July 19th, 1906, in small numbers, by Mr. W. J. Fox and myself.

On October 10th, 1906, a number were seen in a cut-off of the tributary of the Delaware at Trenton Junction, in Mercer county. In one place it was very shallow and warm. Here a school of probably a dozen were seen, each of small or moderate size. In this instance the appropriateness or the specific name was very evident, for on approaching the banks dark objects could be seen moving about, which on close examination proved to be only the shadows of the fish themselves. The latter were hardly evident

in their transparency, though when both were detected, and the fish swam away, it had the appearance of chasing its own shadow!

Found at Pierce pond and in the ditches of New England Creek in Cape May county, October 6th, 1907. Later on, October 15th, 1907, they were found associated with the last about the boggy roots of the cat tails.

Lucania parva (Baird).

Rain Water Fish.

Abundant in the ditches of New England Creek in Cape May county, October 6th, 1907. It associates with *Gambusia,* though is much less active, and prefers clear water with a gentle current. In life largely pale olivaceous in color, and after being in alcohol decidedly straw-colored. Belly and extreme under surface of caudal peduncle whitish. Scales otherwise all with dusky margins, this forming a beautiful network pattern. Upper surface of head dusky, becoming paler on side and lower surface, where it is whitish, though somewhat translucent. From level with eye back to middle of base of caudal a pale underlaid dusky-shaded streak. This appears to be also absolutely interrupted in several places throughout its course. Upper surface of head with pale olivaceous tints. Jaws translucent brownish. Iris brownish with a narrow circle of golden around pupil, which is black. Dorsal pale grayish-olive, anterior membrane of fin with slaty-dusky blotch, and rather large and well-defined. Upper edge of dorsal grayish. Caudal dilute yellowish-olive, becoming paler around margin. Pectoral pale olivaceous-white. Ventral and anal white. Length $1^{3}/_{16}$ inches. They show no noticeable variation, and the above is about as large as they grow.

Cyprinodon variegatus Lacépède.

Pursy Minnow.

Mr. W. J. Fox found examples at Sea Isle City, July 4th, 1906. and small ones were taken on July 19th. Mr. David McCadden

secured it at Ocean City, on August 19th, 1906, where it was common. Their bellies turn red after being placed in alcohol.

Common in fresh and brackish water of Fishing Creek, where it flows over the beach, May 5th, 1907. Also in New England Creek at Higbee's Beach, in the still ponds, especially where there is rotting vegetable matter forming a deep black ooze on the bottom. In such stinking places these little fish swarm by the thousands. They were not brilliantly colored by October 6th, 1907, being only their usual white and lead-colored shades. Young also abundant.

Gambusia gracilis (Heckel).

PLATE 66.

Top Minnow.

Head 3⅗; depth $3^{4}/_{7}$; D. I, 6, 1; A. III, 7, 1; P. I, 11; V. I, 5; scales 30 in a lateral count from gill-opening above to base of caudal and 2 more on latter; 22 scales between tip of snout and origin of dorsal; 11 scales obliquely up and back from origin of anal to that of dorsal; 7 scales in a lateral oblique series on side of caudal peduncle; width of head 1½ in its length; depth of head at occiput about 1⅕; mandible 2½; first branched dorsal ray $1^{5}/_{7}$; first branched anal ray $1^{2}/_{7}$; caudal 1; least depth of caudal peduncle 2; pectoral 1⅛; ventral 2; snout 3 in head measured from tip of upper jaw; eye 3; maxillary 2⅖; interorbital space 1⅞. Body elongate, well compressed, greatest depth a trifle before origin of ventral, upper profile a little more evenly though less convex than lower, edges of body rounded, and general contour rather elongately ovoid. Caudal peduncle long, well compressed, and its least depth 1⅝ in its length. Head moderately small, greatly depressed and broadened above, so that upper profile is a little concave anteriorly and less inclined than lower. Lower profile suddenly ascending anteriorly, this due to rather evenly convex profile of mandible. Snout short, depressed greatly, its length about $^{4}/_{7}$ its width, and profile as viewed from above rather broadly convex. Eye circular, nearly impinging on upper profile, and its center very slightly before middle in its length. Mouth superiorly terminal, protruding

forward when protracted, and then horizontal, though when closed a little oblique. Jaws even when protruding and mandible protruding well in front when closed. Maxillary not quite reaching front of eye, or only about opposite posterior nostril, and extending only a trifle lower than margin of eye. Lips thin and little developed. Edges of jaws rather depressed or flattened, and armed with rather broad bands of fine slender teeth. Roof of mouth apparently edentulous, smooth. Tongue depressed, moderately broad and thin, and hardly free. Nostril a small slit close to upper front rim of eye on side of snout. Interorbital space broad and flattened. Preorbital rather large, with roughened surface, and its greatest diameter about equals that of eye. Posterior margin of preopercle nearly vertical and entire. Gill-opening extending forward midway in length of head. Gill-rakers about 5+12 slender brittle points, longest about $\frac{3}{5}$ of longest filaments. Gill-filaments about $\frac{2}{3}$ of eye. No pseudobranchiæ. Isthmus narrow and triangular in shape, its surface slightly convex. Scales large, cycloid, rather narrowly exposed in longitudinal series with appearance of vertical reticulation due to dark membranes of each pocket. Each scale with a series of rather fine concentric striæ. Head covered with scales, except on jaws and preorbital. Scales on cheeks in 2 series, and large scales on opercle and top of head posteriorly. Scales on breast, belly and base of caudal all smaller than others. Origin of dorsal nearly midway between that of pectoral and base of caudal, and rays graduated down from first branched which is longest, edge of fin rounded. Anal inserted well before dorsal or its origin, nearly midway between front margin of eye and base of caudal, rays graduated down from first branched which is longest. Caudal long, rounded, and median rays longest. Pectoral long, rather large, upper rays longest, fin placed high or with its origin level with upper margin of eye, and depressed tip reaching well beyond base of ventral though apparently not quite opposite vent. Origin of ventral about midway between that of pectoral and that of anal, when depressed reaching vent, and first branched ray longest. Vent close in front of anal. Color in alcohol largely dull olive-brown above, becoming paler on sides and fading whitish below. Muzzle, including all of mandible, trans-

lucent brownish. Iris slaty-brown. A deep brown blotch on cheek below eye. Fins all deep dusky or grayish-brown, except grayish-white ventral. On rays of dorsal a series of 4 small blackish spots, about equally spaced on each ray. On caudal rays a series of 3 conspicuous blackish spots, with alternate obscure ones on each ray. Pectoral and anal immaculate except towards edges where there are very minute pale dusky dots, so that fins shade darker distally. On back a number of obscure dusky spots, irregular and appearing at bases of scales. They are formed simply by more intense dusky at bases of pockets. Adult female. Length $1^{13}/_{16}$ inches. New England Creek, a tributary of Delaware Bay at Higbee's Beach, Cape May county, October 6th, 1907. O. H. Brown, H. Walker Hand and H. W. Fowler.

Head 3¾; depth 3¾; D. I, 6, I; A. III, 7, I; scales 30 in a lateral count from shoulder or upper end of gill-opening to base of caudal, and 2 more on latter; 9 scales obliquely forward from origin of dorsal to base of last anal ray; 23 scales before dorsal; width of head 1⅔ in its length; depth of head at occiput $1^2/_7$; first branched dorsal ray 1¾; least depth of caudal peduncle 1½; pectoral $1^1/_6$; ventral 2½; snout 3 in head measured from tip of upper jaw; eye 2⅗; maxillary 2⅞; interorbital space $2^1/_6$; third simple anal ray 3 in entire length of head and trunk; caudal 3⅗. Body similar to that of female, only comparatively more slender. The only noticeable differences are in the long slender anterior rays of the anal anteriorly, so that when depressed fin reaches ⅗ of space to base of caudal. Of these elongated rays only third simple and first branched are conspicuous. Length $1^1/_{16}$ inches. Adult male. Same data as the above.

Color in life of adult male dull olive-brown generally on back, with a livid shade of translucent grayish on sides. Sides of trunk with a few blackish or dusky spots scattered about, usually at bases of scales, though irregular. Peritoneum showing through body-wall as pale brassy. Head brownish above, paler below to translucent brownish. Iris dusky-brown, paler below, and pupil blackish. Opercle with greenish, emerald and golden reflections. Dorsal and caudal fins similar to back, pale translucent, and marked with several series of black spots. Other fins pale trans-

lucent brownish, anal and ventral much paler. Length about 1¾ inches. The above example, together with many others, was taken in Teal's Branch of Pond Creek, in Cape May county. The water is perfectly fresh, with a gentle current, and flows through woodland, where the fish were obtained, though below is a long stretch of wide marsh. It was, however, clear, and not darkly stained, though the stream was quite choked up with thick aquatic vegetation in and among which the fish seemed to lurk. Though rather hardy they soon die in alcohol. The males seemed to be equally abundant with the females. They were all numerous enough at this locality to be called abundant. A number of examples attain a larger size than any of the average size, and these were always found to be females. Associated with them were *Eupomotis gibbosus,* all small and bluish in color. They were also abundant in still water in New England Creek, a tributary of Delaware Bay in Cape May county at Higbee's Beach, on October 6th, 1907. They were found with hosts of *Palæmonetes vulgaris.* They frequently swam along the bottom, preferring clear running water, or that which has a gentle current. They were not found with *Cyprinodon,* though usually with *Lucania.* Most large examples have brassy and coppery shades on abdomen laterally.

Mr. H. Walker Hand and myself again visited Teal's Branch of Pond Creek, where this species was first discovered, and then further down stream, on October 15th. We found the fish very abundant throughout our exploration. Numbers were taken in woodland, where covered with almost impenetrable thickets. In the open courses of the creeks, especially about the shallows, among the aquatic vegetation these little fish lurk in schools of countless individuals. They are fond of swimming near the surface, and when disturbed swim about in procession through the little channels and thoroughfares in the vegetation, though a whole school may easily be captured in a dip-net. We secured about 1,000, of which only 60% reached Philadelphia alive, though the water was changed shortly after their capture, again at night, and finally the following morning, when they were liberated in large tanks well balanced, etc. They fed well in captivity

upon *Daphnia* and other small aquatic animals. They do not vary much in color, and the males appear in equal if not greater numbers than the females. The large females are rather exceptional, and largest of all probably 1¾ inches. All are spotted with blackish on the back, this fading however in the preserved examples. They are not so hardy as the killies though are as a rule less shy. The whole school seems to move by one impulse when disturbed. They prefer a muddy bottom.

The discovery of this little fish in New Jersey is most interesting, as it has never before been recorded so far to the north along the Atlantic coast of the United States. The fish has been of much interest to the New Jersey Agricultural College Experiment Station as an agent in mosquito extermination. Mr. W. P. Seal has recently presented a paper on the introduction of this species, and *Heterandria,* in New Jersey waters[1] during the fall of 1905. They were placed in brooks flowing into the ice-pond at Westville, a land-locked pond near Delanco, a mill pond between Merchantville and Eavesboro, and land-locked waters near Delair. However, as none of them seem to have thrived or been seen since, the experiment was thought unsuccessful. Though Mr. Seal has suggested to me that possibly the examples I have found about Cape May county may be descendants, or in fact some of the same introduced individuals, I do not think this altogether probable. They are more likely autochthant members of the fauna of the respective streams in which they were found, as this region, so far as both its fauna and flora are concerned, has much in common with that of lower Delaware, Maryland and Virginia. Besides, the fact that they were found associated in a perfectly thriving condition with other predatory species, such as sunfish, would seem to point to the conclusion that they were holding their own, especially as some of the sunfish were quite large. Although Mr. Seal has never met with *Gambusia* in New Jersey he pointed out that it might occur in the southern part of the State, and my investigations certainly seem to bear out this statement. It is however, strange that it should have escaped observation until after the introduction of the species within our limits. The

[1] Rep. Ent. N. J. Agric. College Exp. Sta., 1906 (1907), p. 653.

interest to mosquito investigators in the case of *Gambusia* is due, Mr. Seal tells me, largely to its capability of destroying the *Anopheles* or malaria mosquito larvæ. As these occur usually in very shallow places, often in the merest skim of water, such as over lily pads, etc., the fish by being a top feeder, and also further by the comparatively elongate slender body, is enabled to reach places and carry on its valuable destruction, which would be otherwise inaccessible to deep-bodied or larger species.

Heterandria formosa Agassiz.

Plates 66 and 67.

Least Killifish.

Introduced by the New Jersey Agricultural College Experiment Station, with *Gambusia,* during November of 1905.

Family BELONIDÆ.

(*Mastaccembelidæ.*)

Tylosurus marinus (Walbaum).

Green Gar.

Mr. H. Walker Hand reports it from Green Creek, Cape May county.

Reported from Great Egg Harbor Bay at Somers Point and Beesley's Point, where it is said sometimes to reach 2 feet in length. Known as "gar."

Mr. J. B. Vanderveer, of Trenton, says that he has seen adult "bill fish" skimming along the surface of the water with their bodies entirely out in the air, and inclined more or less perpendicularly. They are very active and gambol about. Two varieties, called "green bill fish" and "blue bill fish," are thought to occur, and sometimes the large ones were eaten by the fishermen.

Mr. R. C. Abbott tells me he found a bill fish which had been caught by the beak or jaws in a fresh-water mussel on the mud flat at Burlington Island. As the tide receded it had left the fish on the mud, the mussel closing its shell and thus retaining its captive.

Family ATHERINIDÆ.

Menidia beryllina cerea Kendall.

Short Finned Silversides.

Color in alcohol pale greenish-yellow over upper surface, paler on sides and together with under surface silvery-white. Edge of each scale on back dusted with grayish dots, and these most pronounced on middle of back. Upper surface of head hyaline brownish, side and lower surface whitish and silvered. A leaden-silvery band from shoulder to base of caudal about equal to diameter of pupil, and turning dusky when long in alcohol. Iris silvery, slightly grayish to dusky above. Fins all more or less transparent, dorsal and caudal slightly olivaceous, other fins pale or whitish tinted. Along base of anal a pale narrow dusky streak of minute dots. Muzzle translucent grayish. Length 2⅜ inches. This is about the maximum size of those captured. They were abundant in the clear water and conspicuously transparent, while *Menidia mendia notata* was rare. When swimming they could always be distinguished, however, by their dark lateral streaks. They also associate with the shrimps, *Gambusia* and *Lucania,* and usually do not swim very far away when disturbed, though always in a compact school. New England Creek, at Higbee's Beach, in Cape May county, October 6th, 1907.

Menidia menidia notata (Mitchill).

Silversides.

Mr. W. J. Fox found a large number taken for bait on July 4th, 1906, and on July 19th, in Ludlam's Bay.

Mr. H. Walker Hand reports the "silver fish" as found everywhere along the sandy shores, and in Delaware Bay from Cape May Point to Green Creek. On May 5th, 1907, they were found swimming around the pockets of the pounds at Green Creek. An adult female was taken full of spawn, which was easily extruded by pressing the abdomen. Rare in New England Creek at Higbee's Beach, in Cape May county, October 6th, 1907.

Reported to occur in abundance at times in Great Egg Harbor Bay about Somer's Point and Beesley's Point. It is known as "white bait."

Family MUGILIDÆ.

Mugil curema Valenciennes.

Mullet.

About Cape May it has been taken all along the surf. They seldom exceed about 8 inches in length.

Family SYNGNATHIDÆ.

Syngnathus fuscus Storer.

Pipe Fish.

A small one was taken in the "sea lettuce" at Ocean City Point, at the entrance of Great Egg Harbor Bay, on August 16th, 1907.

Hippocampus hudsonius De Kay.

Sea Horse.

Taken in Delaware Bay when dredging for oysters from Egg Island to Ship John Light.

Family SCOMBRIDÆ.

Scomber scombrus Linnæus.

Mackerel.

On April 30th, 1907, several were taken, about 10 in all, at Cedar Hummocks, on the bay shore of Cape May county. This is their first occurrence in Delaware Bay so far up, according to the local fishermen. On the ocean front at Cape May about 5 or 6 barrels have been taken at one time.

Scomber colias Gmelin.

Chub Mackerel.

Mr. W. J. Fox reports a number were taken at Sea Isle City on April 29th, 1906.

Albacora thynnus (Linnæus).

Horse Mackerel.

Prof. M. Farr reports a large example was taken near Sandy Hook recently.

Sarda sarda (Bloch).

Bonito.

Mr. Hand reports them from Five Fathom Bank and McCrie's Shoal.

Family XIPHIIDÆ.

Xiphias gladius Linnæus.

Sword Fish.

The 2 examples I reported in 1905 were probably taken at Cape May Point.

Family CARANGIDÆ.

Seriola zonata (Mitchill).

Amber Fish.

A number of small examples, reported by Mr. Hand as "rudder fish," were seen about the stern of a vessel some years ago in Cape May waters.

Taken at Sea Isle City on July 15th, 1907, according to Mr. W. J. Fox, and reported abundant in the pounds in July 19th. Called "pilot fish."

Seriola lalandi Valenciennes.

Hard Tail.

About Sea Isle City on July 19th, 1906, it was reported not common in the pounds, though a few were found at times.

Vomer setapinnis (Mitchill).

Moon Fish.

Reported in the pounds at Sea Isle City July 19th, 1906, by Mr. W. J. Fox, where several were taken.

Selene vomer (Linnæus).

Dollar Fish.

The record I gave for this species in 1905 was based on an example seen on the beach at Cape May. Mr. Wm. J. Fox secured 2 young examples in Townsend's Inlet, Cape May county, on October 13th, 1907.

Trachinotus carolinus (Linnæus).

Pampano.

This species has not positively been identified from Cape May. Small silvery examples, without any yellow, were taken in the surf at Ocean City Point on August 16th, 1907.

Family POMATOMIDÆ.

Pomatomus saltatrix (Linnæus).

Blue Fish.

About Cape May county it occurs along the ocean front, but has not yet been noticed in Delaware Bay above Cape May Point, according to Mr. Hand. Good catches were made in late July at Five Fathom Bank.

They are said to be fished for mostly in May and June about Barnegat Pier, and are mostly shipped to the New York markets. One taken in the lower Tuckahoe River near Beesley's Point, August 17th, 1907. It was about 12 inches long, and was taken on crab bait by Mr. W. B. Davis.

Family STROMATEIDÆ.

Poronotus triacanthus (Peck).

Butter Fish.

Taken at Sea Isle City on July 15th, 1906, according to Mr. W. J. Fox, and on July 23d.

About Cape May it is abundant everywhere in warm weather, occurring all through the sounds and near the inlets, both inside and outside. In Delaware Bay they have been taken as far as Green and Dias Creeks, according to Mr. Hand. Several in the pounds at Green Creek on June 23d, 1907.

Palinurichthys perciformis (Mitchill).

Black Rudder Fish.

About Sea Isle City they were reported to be found in the pound nets occasionally, though never in numbers, on July 19th, 1906. They are not taken on lines. They are good food fish, and do not vary much in color.

Family CENTRARCHIDÆ.

(*Micropteridæ.*)

Pomoxis sparoides (Rafinesque)?

Calico Bass.

Crappies or calico bass were reported by Mr. C. J. Hunt during the cold weather, early in 1907, near Pensauken, in the Pen-

sauken Creek. A few were taken by anglers, though not determined.

Reported to occur in the pond at Grenloch, and in some numbers at Blackwood, Gloucester county.

Acantharchus pomotis (Baird).

Mud Sun Fish.

In a pool near Pensauken, Burlington county, on January 7th, 1906, two were found with the cat-fish already mentioned. One was nearly 5 inches long and the other smaller. They were more dull or pale olive-brown than the pine barrens or cedar swamp examples.

Color in life olive-brown above, becoming brassy on sides, especially on opercle and costal region. On side 5 longitudinal bands of dusky-olive, not very conspicuous. First band along upper profile of back, second just below, third from upper posterior margin of eye, fourth from lower posterior margin of eye, and fifth from below eye. Opercle with a black spot size of pupil. Lower surface of head translucent or very dilute olive. Iris deep olivaceous, narrow ring of rich brownish encircling pupil and inner edge of this very light to golden. Dorsal pale translucent olive, and rayed portion with a few obsolete dusky spots along base. Anal similar, but rayed fin more deeply olive basally, marginally broadly pale slaty, and this color separated by a dark longitudinal streak. Caudal pale olivaceous, marginally slaty, and basally sprinkled with obsolete specks of dusky. Lower and upper margin of caudal translucent, inclining to slaty or grayish. Pectoral transparent or dilute olive. Ventral transparent to whitish or nearly colorless, its anterior margin and spine translucent grayish, and behind this between first and third rays a rather deep dusky shade becoming olivaceous at base of fin. Length about 5½ inches. Taken in the debris along the banks of the Pensauken Creek, near Pensauken, April 28th, 1907. It is rather tenacious and will live some little time out of water.

A single adult was taken in the sphagnum beds of the Rancocas Creek above New Lisbon, Burlington county, May 12th.

1907. Although taken in this dark or deeply stained water it appeared to be more yellowish-olive generally than most examples.

Enneacanthus gloriosus (Holbrook).

Blue Spotted Sun Fish.

Abundant in the pool near Pensauken, along the Pensauken Creek. Many taken on January 7th, 1906, and all adults. Color, when fresh, brownish-olive, spots obscure and dull, though sometimes more or less golden. Anal mostly with a decided dull wine-color tint. No transverse dark bands and opercular blotch size of pupil.

A small example found in the second cedar-stained stream above Dennisville, in Cape May county, on September 19th, 1906.

Color in life olivaceous generally, becoming paler or pale brownish below. Bright coppery reflections on opercle below breast and costal region. Opercle with a black blotch size of pupil. Mandible spotted like side of head. Iris warm purplish with reddish and dusky tints. Body spotted with dilute metallic greenish, most conspicuously so on opercle and side of head. On body underlaid transverse bands rather distinct. Dorsal dilute olive-brown, spotted with pale brownish or milky-green. Anal with a tinge of metallic wine-color, spotted with same tint as on body. Caudal like back, with fine spots similar over greater median portion of membranes, like those on dorsal. Pectoral dilute saffron. Ventral transparent, with basal anterior rays dusky their whole length. Length 3¼ inches. Very abundant in the debris, grass, sphagnum, etc., along the Pensauken Creek, near Pensauken, April 28th, 1907.

Numerous small examples were evidently this species, which were taken in the Rancocas Creek above New Lisbon on May 12th, 1907.

Three small pale examples were taken with *Umbra* in a muddy pool along south branch of Big Timber Creek, near Grenloch, Camden county, on May 19th, 1907. Fins not reddish and spots pale. On October 20th several with ruddy at bases of rayed dorsal and anal fins, and opercular spot nearly as large as pupil,

were taken in this stream nearer its headwaters, or in a pool near Sumner, in Gloucester county. They were associated with the next.

Enneacanthus obesus (Girard).

Spagnum Sun Fish.

Found abundant in the sphagnum at the forks of Cedar Swamp Creek in Cape May county, April 15th, 1907.

Color in life deep dusky-olive, back almost pure olivaceous. Iris beautiful deep warm brown, nearly blackish, with a dark vertical black band passing through and then down over behind eye a deep olive streak to opercle, bounded above and below by 2 dilute coppery-green lines, which are narrow and more or less broken in places. They also encircle jet-black opercular blotch, which is but little smaller than eye, but much larger than pupil. From tip of snout over preorbital to blackish band below eye, and then down along its anterior edge, a narrow, broken line of pale greenish-yellow with a coppery tinge. Posterior margin of infra-orbital black band with similar tinted edge. Lower part of opercle, spot on maxillary and mandible, with same tints. About 7 indistinct transverse blackish bands, fading out below, and several with coppery tints. First band from occiput, second from first 3 dorsal spines, third from middle dorsal spines, fourth from last dorsal spines and origin of rayed dorsal, fifth from last dorsal rays, sixth a saddle on caudal peduncle above, and seventh at base of caudal. Fins all pale brownish, a little dusky towards bases. Rayed vertical fins all finely spotted with gray-brown, at least on median membranes. Anal spines and basal membranes of rayed fin with bluish and lavender or lilac tints. Pectoral and ventral pale or dilute olive, with slightly dusky shade. Abdomen and lower surface of head soiled brownish. Jaws rather deep olive. Length about 2½ inches. Taken by Mr. H. Walker Hand in Fishing Creek outlet at Ross's mill pond, May 5th, 1907. After death it faded to bluish, purplish, etc., on the sides of its head, the iris became more gamboge-brown and the vertical bars more distinct.

One taken in the south branch of Big Timber Creek in a pool in Gloucester county near Sumner, on October 20th, 1907. Opercular dark spot nearly equals iris.

Mesogonistius chætodon (Baird).

Banded Sun Fish.

Abundant in the sphagnum beds about the forks of Cedar Swamp Creek, in Cape May county, on April 15th, 1906. Previously on January 31st, 1906, we also found a number in the same locality, associated with *Umbra*. They were mostly small.

Mr. T. D. Keim reports taking it in the Pensauken Creek near Pensauken in 1906.

In the Rancocas Creek above New Lisbon these little fish were found very abundant on May 12th, 1907. They prefer the concealment afforded in the aquatic vegetation of the cut-offs and little coves. There they were seen in very many places swimming about as usual, and diving suddenly into the plants when frightened or disturbed, only leaving a muddy place to indicate their disappearance. Of the numerous examples taken all seemed darker than those found in Pennsylvania.

Lepomis auritus (Linnæus).

Long Eared Sun Fish.

Several large ones seen swimming about the pond at Turnersville, west branch of Big Timber Creek, in Gloucester county, May 19th, 1907.

Eupomotis gibbosus (Linnæus).

Common Sun Fish.

Several in Crosswicks Creek near Trenton on July 15th, 1906.

Found in Kinkora Creek near Kinkora, Burlington county, on October 10th, 1906. Mr. Hand has secured it in Cape May

county in Ross's mill pond tributary to Fishing Creek, the head of Dias Creek and Green Creek Run. Mr. Henry Warrington secured young in the Rancocas near Medford, Burlington county, in January of 1899.

Color in life very dark deep dusky, inclining to blackish or with general tint blackish-olive. Sides with vertical dusky-edged ocelli, centers of which are of deep dull crimson or blood-stained tint, and those intervening over obsolete transverse bands more red than others, which are tinged with warm olive. Sides of head with pale streaks, metallic colored, and tinged with dilute coppery, pale bluish and greenish. Intervening wavy dark spaces on side of head tinged with beautiful copper and saffron. Belly and lower surface of abdomen dirty saffron, or with dusky tinge. Lower surface of head livid dusky-grayish, and also with a dilute bluish or greenish tinge. Opercular blotch jet black, margined posteriorly with deep carmine. Iris dusky-olive. About 9 underlaid transverse obsolete bands of blackish, and rather indistinctly defined. First band on occiput, second from middle of predorsal region, third from bases of third and fourth dorsal spines, fourth from bases of fifth to seventh dorsal spines, fifth at bases of last 3 dorsal spines and origin of rayed dorsal, sixth from middle of base of rayed dorsal, seventh from last dorsal rays, and eighth and ninth on caudal peduncle above. Fins all dusky-olive, membranes largely with blackish. Pectoral, ventral and anal deep dusky, tinted with deep saffron or a dark shade of belly. Length 5 inches. I captured this example in a hole, in cold running water, at Ross's mill pond, Cape May county, on May 5th, 1907.

One taken in the west branch of Big Timber Creek in the pond at Grenloch, Gloucester county, May 19th, 1907, was rather pale.

Mr. S. H. Hamilton reports it as abundant in Lake Hopatcong.

Small sun fish were abundant in New England Creek at Higbee's Beach, on October 5th, 1907. They were usually under banks and in weeds. Not bluish, though otherwise brightly colored, with reddish fins, and dark vertical bars not pronounced. Found in Teal's branch, associated with *Gambusia,* on October 15th. They were then abundant in the weeds. A rather light colored example about 4 inches long was taken.

In south branch of Big Timber Creek, near Sumner, on October 20th, 1907, Mr. B. W. Griffiths and myself found this species rather abundant.

An example about 5 inches long was very similar to those taken in upland Pennsylvania waters, and of the ordinary brilliancy. The pumpkin-seed spots are dull golden or deep dusky-golden. Blue lines on side of head ordinary pale blue. Opercular spot margined behind with deep scarlet. Belly bright orange, also breast. About 10 transverse dorsal bands, dusky in color, distinct. Lower surface of head pale translucent heliotrope to gray. A number of other examples were found in the pools, some smaller, and others very pale. Young found in south branch of Cooper's Creek on same date, at Gibbsborough, Camden county.

Micropterus salmoides (Lacépède).

Large Mouthed Black Bass.

Reported from Lake Hopatcong by Mr. S. H. Hamilton.

One about 8 inches long was taken in the mill-pond of the south branch of Big Timber Creek at Clementon, in Camden county, on October 20th, 1907.

Family PERCIDÆ.

Perca flavescens (Mitchill).

Yellow Perch.

Reported to occur in Kinkora Creek, near Kinkora, Burlington county, on October 10th, 1906.

Reported to reach some size in the pond at Grenloch, Gloucester county. Said to reach a foot in length.

Boleosoma nigrum olmstedi (Storer).

Tessellated Darter.

Abundant in Edward's Run, a branch of Mantua Creek, in Gloucester county, on November 3d, 1907.

Boleichthys fusiformis erochrous (Cope).

Darter.

Three taken in Crosswick's Creek, near Trenton, on July 15th, 1906. Mr. Henry Warrington secured it in the Rancocas Creek, near Medford, in January of 1899.

Family SERRANIDÆ.

Roccus lineatus (Bloch).

Rock.

Reported as "rock" in the tide-water of Dennis Creek, in Cape May county. In the latter it occurs all along the surf and bites well in Corson's Inlet, which is famous for its "rock fishing." They are also angled at Scotch Bonnet and Gray Channel. In Delaware Bay they occur from Cape May Point to Dennis Creek, and are also angled further up or at Maurice River. One taken at Wildwood in 1906 weighed 32 pounds, according to Mr. Hand. Recently, an example was taken in Cape May Inlet weighing about 15 pounds.

Several small ones found in the ponds at Green Creek on May 5th, 1907. They had all passed up the bay by June 9th.

Reported from Somers Point and Beesley's Point in Great Egg Harbor Bay early in the summer. Also taken in the Tuckahoe River to the bridge, according to reports.

Mr. J. B. Vanderveer, of Trenton, says the largest example he knows of taken in the river weighed 33 pounds. He thought that the rock fish spawns in Delaware Bay, though the young were taken in summer.

Morone americana (Gmelin).

White Perch.

Reported to occur in the tide-water of Dennis Creek, in Cape May county. It ranges along the bay-shore from Cedar Hum-

mocks, at Dias Creek, down to Cape May Point. On the ocean-shore they are fished up to Stone Harbor. It has been taken in Cold Spring Inlet. In a landlocked brackish water pond a number of these fish, together with herring, weak fish and goodies were taken one winter at Cape May Point, according to Mr. H. Walker Hand. The white perch also occurs in all the inland waters. Several were found on the beach at Green Creek on June 9th, 1907.

Reported at Barnegat Pier on July 30th, 1907, and later in Great Egg Harbor Bay at Somers Point and Beesley's Point. Said to run up the Tuckahoe, where they have been taken at the bridge.

Reported from Kinkora Creek, near Kinkora, in Burlington county.

Centropristis striatus (Linnæus).

Sea Bass.

Taken at Sea Isle City on July 15th, 1907, according to Mr. W. J. Fox,

About Cape May, Mr. H. Walker Hand says they are not so plentiful as the white perch. They reach a weight of 7 pounds and are comparatively short and chunky. They run in all salt-water inlets and channels. In Delaware Bay they occur from Cape May Point to Dias Creek at least, where about 2 or 3 are taken at a time. Recently they have also been reported as far up as Cohansy Creek. They are hard to gill and wary of gill-seines. In the summer of 1906 some adults were taken in the bay with "humps" or conspicuous backs. In late July of 1907, sea bass were taken at Fourteen Foot Bank. Small examples are taken in Great Egg Harbor Bay about Somers Point, Beesley's Point and Ocean City, according to the fishermen. They are said to worry their bait when fishing.

Family HÆMULIDÆ.

Orthopristis chrysopterus (Linnæus).

Hog Fish.

Mr. H. Walker Hand reports one from Cape May, in one of the sounds, late in July of 1907. It was caught on a hook. Known as "hog fish."

Family SPARIDÆ.

Stenotomus chrysops (Linnæus).

Porgy.

Mr. W. J. Fox noted it at Sea Isle City, July 15th, 1906.

This fish runs in Delaware Bay with the sea bass from Cape May Point to Green Creek, where, however, very few are taken.

Archosargus probatocephalus (Walbaum).

Sheep's Head.

Mr. Hand reports they have been taken back of Avalon and at Turtle Gut, in Cape May county. About twenty years ago a few large ones were taken in Delaware Bay and off the "drum-beds".

Family SCIÆNIDÆ.

Cynoscion regalis (Schneider).

Weak Fish.

Noted at Sea Isle City on July 15th, 1906, by Mr. W. J. Fox. On July 23d about 30 pounds were taken. About Cape May they reach a fair size, or about 12 pounds, and some have been reported of 14 pounds in weight. In the Delaware Bay they run up as far as Ship John Light and at Cohansy Creek, where they are larger than off Green Creek. They occur all along the ocean shore. Found abundant and some quite large, in the pounds at Green Creek, May 5th, 1907. Abundant on June 9th. It is the most prized food fish of this region. Rather few were taken in the pounds on June 23d. They are sometimes known locally as "blue fish." Mr. H. Walker Hand reports that weak fish were taken in record quantities everywhere about Cape May in late July, in both the bay and sounds. They were also taken at Fourteen Foot Bank. They ran small, however, and were reported in the bay as far as Cohansy Creek.

About 300 were taken in a few hours at Barnegat Pier on July 30th, 1907. They were mostly small, running about 2 or 3 pounds. They constantly uttered their hoarse trill when thrown in the live-box.

On August 17th, 1907, a number were taken on crab-bait in the lower Tuckahoe River near Beesley's Point. They were also reported in Great Egg Harbor Bay from Somers Point and Ocean City. During August weak fish were taken in Delaware Bay at Dias Creek.

Cynoscion nebulosus (Cuvier).

Southern Weak Fish.

About Cape May this is caught in the sound though not in the Delaware Bay. It has been taken opposite Oman's Creek, at Stone Harbor, Grassy Sound, The Folly in Swain's Channel, Mill Creek, Middle Creek and Lower Thoroughfare. They bite well on crab and shrimp bait and appear late in June to remain till September. They run smaller than the weak fish and usually reach about 2 pounds. Called "trout," "spotted trout," "spotted weak fish" and "southern weak fish." Mr. H. Walker Hand reports an example of 9 pounds in weight taken in Middle Thoroughfare at Cape May in the early fall of 1907. It was the largest he ever saw.

Reported to occur in the pounds occasionally at Barnegat Pier, and known as "trout." In Great Egg Harbor Bay according to the fishermen "sea trout" have been reported occasionally from Somers Point and Beesley's Point.

Sciænops ocellatus (Linnæus).

Channel Bass.

On July 19th, 1906, they were reported to be frequently taken in Corson's Inlet. They are said to run to about 40 to 50 pounds and to occur in the deep water of the channel.

They run up Delaware Bay to Pierce's Point and are reported to occur at Egg Island on the oyster grounds by oystermen. They take fish-bait and crabs, and run about 60 pounds in weight. Off shore they have been taken at Five Fathom Bank, McCrie's Shoal and north of Corson's Inlet, according to Mr. H. Walker Hand.

Reported to occur at times at Barnegat Pier.

Leiostomus xanthurus Lacépède.

Cape May Goody.

About Cape May they occur along shore though are becoming scarce. In Delaware Bay they range from Cape May Point to Cedar Hummocks. They are taken in surf-seines, and angled, though not in deep water. At times quite large ones have been noticed.

Micropogon undulatus (Linnæus).

Croaker.

Noted at Sea Isle City on July 15th, 1906, by Mr. W. J. Fox. Along the shores of Cape May county they are frequently taken, and in Delaware Bay range from Cape May Point to Green Creek off the Hummocks, where about 300 pounds were taken in a single day during July of 1907. Mr. Hand reported one 3 pounds in weight caught in Mill Creek. Others of less size were taken at Fourteen Foot Bank.

Menticirrhus saxatilis (Schneider).

King Fish.

About Cape May they are taken in the inlets and around sand-bars. They are good market fish, running about 1½ pounds. Taken at McCrie's Shoal, though seldom on Five Fathom Bank according to Mr. Hand. During the past August they have been taken up Delaware Bay as far as Dias Creek, according to the fishermen.

On August 17th, 1907, they were abundant in the lower Tuckahoe River near Beesley's Point, and took crab-bait readily. They were also reported from Somers Point and Ocean City in Great Egg Harbor Bay. Known as "king fish."

Pogonias cromis (Linnæus.)

Drum.

Very abundant up Delaware Bay, from Cape May Point to Egg Island. About 20 years ago 70 were taken in a sturgeon-net at Green Creek. They attain 96 pounds in weight. Many remains of large examples were found along the bay shore at Green Creek on June 9th, 1907. They are frequently taken in the pounds. A large example, about 3½ feet long, was found on the beach June 23d, 1907, at Green Creek. They were generally thought not to bite so well, when croaking, about Cape May.

Charles Gamion of Cape May Court House caught 200 in one haul of the seine at Great Channel on June 8th. 1907. They were then biting freely in the bay from Cape May Point to Green Creek.

Reported to occur at Barnegat Pier. In Great Egg Harbor Bay they were reported to travel at high-water to and from their special feeding-grounds. They then usually swim near the surface of the water, and are often harpooned. Reported from Beesley's Point and Somers Point.

Early in August of 1907 Mr. McCadden reported one washed ashore at Ocean City. Along the ocean front at this place they are fished in the surf, and have also been reported to have been fished in the same way at Sea Isle City, Peermont and Stone Harbor.

Family LABRIDÆ.

Tautogolabrus adspersus (Walbaum).

Bergall.

Color when fresh deep livid purplish-brown, with deep olivaceous reflections. Centre of each scale with a deep coppery-

golden or gilded blotch so as to form longitudinal series parrallel with lateral line, and latter also with same tint. Upper surface of head deep purplish-brown with brilliant though obscure blotches on cheek and opercle. Lower surface of head livid or translucent heliotrope to whitish or grayish. Upper jaw dull dusky, and lower still paler. A pale blue-green tinge on preorbital. Iris very deep and beautiful purplish. Back with about 9 very obscure underlaid deep dusky diffuse saddles transversely, and each much broader than interspaces. First on predorsal region, others from bases of dorsals, eighth on caudal peduncle above, and last at base of caudal. Dorsals, anals and caudal pale brownish marginally or over greater marginal extent, and becoming deeper on middle portions of each longitudinally, though with deeper ventral tint. Bases of dorsals livid dark gray. Base of caudal obscure dusky-gray with purplish tinge and thickly spotted with obscure deep coppery dots of small size on scales. On membranes mottled with pale gilt and gamboge to dusky. On median portion of posterior half of spinous dorsal, and all of rayed dorsal, scattered obscure coppery to dull golden small specks or spots of irregular size. Base of anal livid gray-greenish to whitish, this color receding backwards. Pectoral pale heliotrope, translucent, and very slightly grayish at base of fin. Ventral translucent grayish, slightly tinted gray-lavender in middle of fin, and spine gray. Length 5¾ inches. Taken in Townsend's Inlet near Avalon, Cape May county. October 20th, 1907. W. J. Fox. Called "bergall."

Mr. Fox also secured one in Corson's Inlet in August of 1906.

Tautoga onitis (Linnæus).

Black Fish.

Now found in Cape May Harbor around the pilings. They also haunt steep mud-banks. In size they reach about 1½ pounds. A small dessicated example was found on the flats at Green Creek on June 9th, 1907. It was about 10 inches long. In late July they were taken at Fourteen Foot Bank. They were reported during the past season to ascend Delaware Bay to Cohansy Creek.

Family BALISTIDÆ.

Balistes carolinensis Gmelin.

Trigger Fish.

Mr. Hand reports that a fish, probably this species, has been seen in the pounds at Cape May Point.

Family MONACANTHIDÆ.

Alutera schœpfii (Walbaum).

Orange File Fish.

Noted at Sea Isle City on July 5th, 1906, by Mr. W. J. Fox.

Family TETRODONTIDÆ.

Spheroides maculatus (Schneider).

Puffer.

One was secured at Sea Isle City on July 1st, 1906, by Mr. W. J. Fox. Again noted on July 15th.

This fish occurs all along the shore of Delaware Bay from Cape May Point to Green Creek. Abundant all along the bay shore at Green Creek on June 9th, 1907. The largest examples were about 10 inches long. One found on June 23d. Called "toad fish."

Spheroides testudineus (Linnæus).

PLATE 68.

Southern Puffer.

Distinguished from the last by the very broad, flattened interorbital space, its width more than one-half the snout.

This species is included upon the authority of Dr. W. C. Kendall. He writes that there is an example in the U. S. Nat. Mus. about a foot in length, collected by S. F. Baird at Beesley's Point.

Family MOLIDÆ.

Mola mola (Linnæus).

Sun Fish.

Mr. Hand says that the example reported from Cape May was washed ashore at Mount Vernon. During the summer of 1906 another was reported from the Holly Beach pounds.

Family TRIGLIDÆ.

Prionotus carolinus (Linnæus).

Sea Robin.

Reported at Sea Isle City on July 1st, 1906, by Mr. W. J. Fox. Reported from Ocean City and in Great Egg Harbor Bay at Somers Point and Beesley's Point during August of 1907.

Prionotus evolans strigatus (Cuvier).

Flying Fish.

Noted at Sea Isle City on July 15th, 1906, by Mr. W. J. Fox. About Cape May, sea robins with long pectorals are often taken off shore, which are probably this species. They take fish bait and run about 10 inches in length. Taken on Five Fathom Bank, McCrie's Shoal and an Old Eph Buoy. One found on the beach at Ocean City Point on August 16th, 1907.

Family ECHENEIDIDÆ.

Echeneis alba-cauda Mitchill.

Suck Fish.

Several "leeches" about two feet long were noted on the large shark taken near Palermo in 1888, and were evidently this species.

On another occasion one was found on a shark about 6 feet in length, the remora itself being about 2 feet long. Possibly *Remora remora* (Linnæus) may occur at Palermo, also as fishermen describe a short and more chunky "leech" than the present species. One was taken in the pound at Sea Isle City, July 18th, 1906.

A sand shark, taken on the bay-shore of Cape May county, at Green Creek, had two slender suckers attached, which were evidently this species.

Family PLEURONECTIDÆ.

Lophopsetta maculata (Mitchill).

Window Light.

Abundant in the pounds at Sea Isle City on July 19th, 1906, according to reports.

Common about Cape May in the sounds and in Delaware Bay from Cape May Point to Green Creek. About Green Creek on May 5th, 1907, it was found abundant in the pounds. Many were brought ashore and spread about the fields as fertilizers. They were mostly small, and ranged up to 12 inches. Several small examples were found on the beach June 9th.

Paralichthys dentatus (Linnæus).

Summer Flounder.

Quite a number were taken, about 100, on July 1st, 1906, and young were taken July 4th at Sea Isle City. About Cape May, off-shore, they have been taken on Five Fathom Bank and at McCrie's Shoal nearly 3 feet long. In Delaware Bay they run from Cape May Point to Green Creek at least, at the latter locality on May 5th, 1907, they were found equally abundant with *Lophopsetta* and in similar locations, though reaching a larger size. Many were quite 2 feet in length.

Abundant at Green Creek on June 9th. Next to the weak fish it is the important food fish of the region. Examples of all ages

were found. A number of examples about 10 inches long were taken June 23d in the pound, and a large one was reported. Reported in August of 1907 in Great Egg Harbor Bay at Ocean City, Somers Point and Beesley's Point.

Limanda ferrunginea (Storer).

Fluke.

The example I have already credited to Mr. Hand from Cape May was taken at Sewell's Point in a hauling-net, in the 90's.

Pseudopleuronectes americanus (Walbaum).

Winter Flounder.

A small flounder taken as late as November in the hauling-nets has been common. It occurs in and along shore and in Delaware Bay from Cape May Point to Green Creek.

Family SOLEIDÆ.

Achirus fasciatus Lacépède.

Sole.

One found at Green Creek on June 23d, 1907.

Family OPHIDIIDÆ.

Rissola marginata (De Kay).

Sand Cusk.

Color when fresh very pale brownish generally with translucent and slightly silvery effects, in some lights pale brassy. Upper surface of trunk and tail minutely dotted with pale dusky along edge of each scale so as to form a very finely reticulated pattern. On tail or after vent lower marginal portion of trunk somewhat

similar to back, leaving a longitudinal streak immediately below median axis. From shoulder back to base of caudal, and bounding upper portion of longitudinal immaculate area of tail a pale gilded-brassy narrow streak, and this forming about midway in axis of latter. Lateral line a slightly brownish shade, its entire course making it appear pronounced. Upper surface of head dusky like back, only dots more numerous and therefore appearing a litle darker. Snout same shade. Lower surface of head pale translucent whitish, with silvery sheen. A slight underlaid dusky shade showing through on opercle. Lips pale translucent. Iris silvery, shaded a little dusky above. Peritoneum showing through abdomen as rather bright silvery, surface of which is immaculate. Fins all pale translucent brownish, edges of confluent unpaired ones at first rather pale, but posteriorly both dorsal and anal deep dusky-brown, and when caudal is reached edges of all are nearly blackish. Pectoral scarcely darker above or distally. Ventral whitish. Length about 4 inches. August 21st, 1907, Miss Daisy McCadden. Found about a foot under the sand at Ocean City along the beach. They are active to some extent, and soon bury themselves into the sand, tail first, so that they are able to disappear much sooner than the ordinary beach clam. Another was taken by Mr. McCadden on September 8th at the same locality.

Family AMMODYTIDÆ.

Ammodytes americanus De Kay.

Sand Lance.

Color when fresh pale hyaline-olive or greenish above and on upper surface of head. Sides of head and body, also lower surface of both, white. Former with a bright silvery or mercury tinge and in some lights reflecting pale violet-blue. Snout and end of mandible pale olivaceous, like top of head. Iris silvery-white. Dorsal pale olivaceous, also caudal, though latter with a dusky tint basally. Along side of caudal peduncle silvery lateral band resolves into olivaceous or slightly dusky. Other fins all

more or less transparent whitish. Length 2⅜ inches. Sea Isle City. July 30th, 1907. W. J. Fox.

One was found at Ocean City on October 13th, 1907, by Mr. David McCadden.

Family BATRACHOIDIDÆ.

Opsanus tau (Linnæus).

Oyster Fish.

Mr. W. J. Fox and myself saw a small example in Ludlam's Bay, at Sea Isle City, on July 19th, 1906. It occurs in Delaware Bay from Cape May Point at Green Creek, on the oyster and clam beds, and is common in the shallows about such places. One found at Green Creek on June 23d, 1907.

Family GADIDÆ.

Microgadus tomcod (Walbaum).

Tom Cod.

About Cape May it is taken off-shore, and in the sounds along the ocean, in the fall.

Gadus callarias Linnæus.

Cod.

About Cape May they are abundant off-shore. They appear late in October and leave in March. Occasionally a few are taken in the deep water in April and May.

Phycis regius (Walbaum).

White Spotted Hake.

Color of young when fresh grayish-olive above and on upper sides, each scale with a blotch of very slightly darker tint than ground-color. Head about like back. A grayish-brown obso-

lete streak down posteriorly from lower margin of eye towards lower base of pectoral. Another slightly more distinct from lower margin of eye down towards base of ventral. Back of eye on each side of head 4 blackish spots, uppermost level with upper margin of eye, next level with upper margin of pupil, and others in dark streaks. Still further back, on opercle, are 2 others, one above other. Along lateral line, which is deep brownish, a series of about 16 round white spots, distinct, and largest after pectoral fin. Under surface of head, maxillary, and lower third of trunk, white. Lips and mandible with gray-brown specks or dustings. Dorsals and anal translucent brownish-gray basally, and becoming blackish marginally, this very distinct on spinous dorsal as its median portion is more whitish. Caudal dusky-gray. Pectoral pale or whitish, specked or shaded with brownish-gray above. Ventral white. Iris silvery-white, slightly grayish above, and pupil slaty. Length 5½ inches. Taken at Sea Isle City on July 25th, 1907. W. J. Fox.

Family MERLUCCIIDÆ.

Merluccius bilinearis (Mitchill).

Frost Fish. Whiting.

About Cape May the whiting is taken in winter while cod-fishing. It has been found at the northeast end of Five Fathom Bank and northeast on McCrie's Shoal. During the past November and December frequently about Cape May. Mr. James Boyce secured a large example at Asbury Park on December 22, 1907, now in my possession. They are called frost fish at that locality, as they are found washed ashore in numbers at times during the night. When seen lying on the beach their silvery color enables one to locate them at such times, especially as they flap about in the retreating undertow.

Family LOPHIIDÆ.

Lophius piscatorius Linnæus.

Angler.

Color when fresh with lower part of body pale or dull livid gray-white, becoming perhaps a trifle darker on lower surface of tail. Anal somewhat dusky, with distinct pale or gray-white margin. Pectorals livid gray-white below, largely over greater basal portion, and outer margins broadly dusky-brown to blackish. Caudal similar to anal, and lower margin toward base of fin similarly pale. Upper surface of body deep drab-brown, very finely marbled or vermiculated with deeper color, and producing a beautiful checked appearance everywhere. These markings even extend over lips and iris, which is of same general tint, though with a light ground-color. Pectorals narrowly pale brownish, and submarginally with deep color of back. Fringes brownish. Bait brown. Caudal and dorsal similar to back, former with vermiculations assuming horizontal course as lines similar to rays. Length about 33 inches. Cape May. January 11th, 1907. H. Walker Hand.

3. A Supplementary Account of New Jersey Amphibians and Reptiles.

Observations and notes, made since the preparation of my account on these animals, are here given. Although no forms new to the fauna are included, except the scarlet snake, which had been omitted in my original account, interesting information of some others is now offered.

Family AMBYSTOMIDÆ.

Ambystoma tigrinum (Green).

Tiger Salamander.

Mr. Hamilton reports he has observed it at Mullica Hill, Princeton and near Trenton. Mr. O. H. Brown found it plentiful in the pond at Cold Spring, Cape May county, some years ago.

Family PLETHODONTIDÆ.

Plethodon erythronotus (Green).

Red Backed Salamander.

I found red-backed examples of this species at Higbee's Beach, within three-quarters of a mile of the ocean, in Cape May county, on October 6th, 1907.

Spelerpes ruber (Daudin).

Red Salamander.

Mr. J. A. G. Rehn found it at Stafford's Forge, Ocean county, on May 20th, 1907.

Family PLEURODELIDÆ.

Diemictylus viridescens (Rafinesque).

Newt.

Mr. S. H. Hamilton found the red land form very abundant at Woodport on Lake Hopatcong. Several were noted at Oxford in Warren county. They usually appeared in abundance after rains.

Family BUFONIDÆ.

Bufo americanus Holbrook.

Toad.

Many were heard with the chorus of "peepers" on the tide marshes about May's Landing, Atlantic county, on April 22d, 1905. Later they were heard up the Great Egg Harbor River nearly to Mare Run. Heard calling occasionally about Green Creek in Cape May county, May 5th, 1907. Abundant, though small, about Wildwood Junction and Green Creek in Cape May county, on June 9th, 1907. On June 23d medium-sized examples were found over most of the woodland, varying in general color but little from a dull sandy-gray. A small fresh pond had evidently been the scene of the recent metamorphosing of the numerous little ones found jumping near by. In some places they fairly swarmed, and hopped about in any direction. I found this species on the salt marsh at Barnegat Pier, Ocean county, on July 30th 1907. A few were seen about Ocean City during August of 1907. I have recently compared all the material reported from New Jersey with that from Pennsylvania and Delaware, and with the exception of a single example, taken in the latter State at Medford Mills, find them all to belong to *Bufo americanus*. This species upon comparison with examples from the southern United States also seems to differ sufficiently from *B. lentiginosus,* a name which I adopted for our form in my last account. Therefore, the name *B. americanus* may be used in its place. The single example

noted above, from Delaware, may be *Bufo fowleri,* though I have no material for comparison. The examples I have already reported from the head of the Batsto River, in Burlington county, and Beamersville, in Sussex county, have the breast or belly well speckled with blackish, while those from Stafford's Forge in Ocean county, Atlantic City in Atlantic county, Bear Swamp to Batsto River in Burlington county, and Cape May Point, all show their under surfaces immaculate or with a single median dusky blotch, and this sometimes faint. They also appear to have more numerous and finer excresences on the back.

Mr. S. H. Hamilton found it at Oxford in Warren county.

Acris gryllus crepitans (Baird).

Cricket Toad.

Frequently heard about Green Creek, in Cape May county, in the pools of fresh and tide-water, on May 5th, 1907. Heard at intervals about the swamps near New Lisbon, Burlington county, on May 12th, 1907. Also found at Green Creek on June 9th, 1907, and on June 23d. On the latter date they were uttering their rattling notes in the afternoon. Small green tree toads reported by Mr. S. H. Hamilton from Bethlehem Cut, between Oxford and Washington, were heard commonly during the summer, and were probably this species. Abundant about ditches, especially in places where cattle have tramped about the mud, at Higbee's Beach, near Pond Creek, on October 6th, 1907. They varied greatly in color, some with snout brilliant and comparatively large expanse of grass-green over their backs compared with pale ones, which are either brownish or gray. About New England Creek, and in the dry fields, roadsides and woods, they were very abundant. All these were, however, pale or grayish in color, suggesting more young of *Bufo.* Found near Sumner in Camden County on October 20th, 1907.

Hyla pickeringii (Holbrook).

Pickering's Tree Toad.

Heard in large chorus on the tide marshes below May's Landing, Atlantic county, on April 22d, 1905. Later, or for several

days subsequent they were heard, usually in the evening, along the Great Egg Harbor River and about Mare Run. Several were also heard on April 8th, 1906, on the tide-marsh at Mantua, of Mantua Creek, in Gloucester county. Heard occasionally on the marshes about Green Creek in Cape May county, on May 5th, 1907. Heard at New Lisbon, in Burlington county, occasionally, on May 12th, 1907.

Hyla andersonii (Baird).

Anderson Tree Toad.

Mr. J. A. G. Rehn has reports of one seen August 16th, 1907, at Stafford's Forge, in Ocean county. It was probably driven from the woods by a forest fire. Mr. O. H. Brown reports that he thinks he has observed it some years ago at Cold Spring, in Cape May county.

Hyla versicolor Le Conte.

Tree Toad.

Mr. S. H. Hamilton found it at Oxford, Warren county.

Family RANIDÆ.

Rana pipiens Schreber.

Leopard Frog.

Small brown example found at Green Creek in Cape May county on May 5th, 1907, and others were heard croaking like those found up the river about Delanco and Burlington. Found at Green Creek on June 9th and 23d, 1907. Abundant on the meadows at Barnegat Pier, Ocean county, on July 30th, 1907. Tadpoles found at New England Creek at Higbee's Beach, on October 6th, 1907, were evidently this species.

Rana virgatipes Cope.

Sphagnum Frog.

The clack, clack, clack, clack, clack of this frog could be heard about the Rancocas Creek above New Lisbon, in Burlington county, on May 12th, 1907. It occurred at intervals, interrupting the stillness of a backward spring. Though loud and not often uttered, in comparison with those found at Mare Run, their croaking could be heard at quite a distance. Sometimes the animals must have been quite close, for we could hear them when but a few feet away without seeing them. It may have been that the weather was too cold, for their croaking was always located as coming from among the submerged and overgrown vegetation along the banks. In such places the temperature was considerably higher by mid-day than elsewhere. When Mr. Hunt visited this place just a year previously, the frogs were very numerous. The weather at that time, however, though about the same time in May, was much warmer. In the evening, during the night, and in the early morning, they were very noisy, but during the day were more or less quiet, only an occasional croak being heard at intervals, or as noted above. We found a lot of spawn, though were unable to identify it as belonging to this species. It resembled that found in Mare Run, in similar situations, as it was formed in strings and wound about the numerous aquatic plants in still water. These strings were quite long and very abundant. Attempts at their transportation and hatching failed.

Rana catesbeiana Shaw.

Bull Frog.

Found at Green Creek on June 9th, 1907.

Mr. S. H. Hamilton found it at Woodport in Lake Hopatcong, Hurdtown and Mount Hope in Morris county, and in the pond at Oxford Furnace, in Warren county. On one occasion large examples were found crawling through briars and thick vegetation, evidently in an attempt to scrape off a number of leeches which

had fastened themselves on the frog. A young one was found in New England Creek, in Cape May county, at Higbee's Beach, on October 6th, 1907.

Rana clamata Daudin.

Green Frog.

Found near Pensauken, Burlington county, on April 28th, 1907. Found in the Rancocas Valley, near New Lisbon, Burlington county, on May 12th, 1907. Found a single example near Turnersville, Gloucester county, on May 19th, 1907. Found at Green Creek, in Cape May county, on June 9th, 1907. Mr. O. H. Brown secured two examples at Teal's Branch of Pond Creek at Higbee's Beach, Cape May, in December of 1907.

Rana palustris Leconte.

Pickerel Frog.

This is the most abundant frog in the south branch of Big Timber Creek, Camden and Gloucester counties. It is found about meadow-ditches of clear water, where there is much long grass, near Grenloch, Camden county. When disturbed they jump into the water, but immediately make for shore, and then climb out again along the stalks of the long grass. Very numerous tadpoles probably belonging to this species, on May 19th, 1907. Mr. S. H. Hamilton reports it from the lowlands at Mount Hope in Morris county, and Oxford in Warren county.

Family COLUBRIDÆ.

Natrix sipedon (Linnæus).

Water Snake.

A large example found in the Rancocas Creek, near New Lisbon, Burlington county, on May 5th, 1907. A small one found near Clementon, in Camden county, on October 20th, 1907. Mr. J. E. Richardson says he has seen it in Clementon Lake and at Oak Lynn.

Storeria dekayi (Holbrook).

DeKay's Brown Snake.

One seen near Fort Lee in Bergen county, in 1905, by Mr. S. H. Hamilton. Mr. J. E. Richardson reports it from Oak Lynn in Camden county.

Opheodrys æstivus (Linnæus).

Summer Snake.

Color when fresh, olive-green on back, upper surface of head and tail, and turning to bright oil-green along sides of body. Under surface of body largely primrose-yellow, though on tail below it becomes citron-yellow, and on lower surface of head wax-white. Upper labials all with more or less whitish and between this color and dark shade of head above oil-green tinge. Iris largely dull blackish with whitish circle around pupil. Inside of mouth livid brownish. Length 27 inches. Stafford's Forge in Ocean county, June 9th, 1907. J. A. G. Rehn.

Mr. J. E. Richardson reports it from Sicklerville and about a mile north of Point Pleasant, in Camden county, and Newtonville in Atlantic county.

Liopeltis vernalis (Harlan).

Green Snake.

Abundant at Mount Hope in Morris county, according to Mr. S. H. Hamilton.

Bascanion constrictor (Linnæus).

Black Snake.

A large dead example was found at Green Creek, in Cape May county, on June 9th, 1907. Mr. J. A. G. Rehn says they were formerly very abundant at Absecon. Mr. J. E. Richardson says he found it around Clementon, near Sumner, Pine Hill, near

Point Pleasant, in Egg Harbor Swamp below Dicktown, near Williamstown Junction, near Sicklerville, and a mile below Albion in Camden county. It was reported as rather common around Clementon.

Pituophis melanoleucus (Daudin).

Pine Snake.

Mr. C. J. Hunt records it during the past summer at Chatsworth in Burlington county. Mr. J. E. Richardson reports several he saw about Clementon. One was seen half-way between Clementon and Point Pleasant, and another half-way between Sumner and Albion. He also said they were reported to be abundant about Brown Mills in Burlington county.

Thamnophis sirtalis (Linnæus).

Garter Snake.

Abundant at Mount Hope in Morris county, according to Mr. S. H. Hamilton. Mr. J. E. Richardson says he saw it at Oak Lynn. I have seen it at Cape May Point during the past October.

Lampropeltis getulus (Linnæus).

Chain Snake.

Mr. C. J. Hunt found a large example at Whitings, in Ocean county, during the summer of 1907. He also noted this species at Chatsworth, Burlington county. Called "wamper."

Lampropeltis doliatus clericus (Baird and Girard).

House Snake.

House snakes are found at Oxford Furnace, in Warren county, according to Mr. S. H. Hamilton. They are usually more frequent in early spring and are thought by the farmers to

carry off small or very young chickens. Like most all snakes in this region they are locally known as the "pilot." They may be probably this subspecies. Mr. J. E. Richardson reports it from Moorestown.

Heterodon platyrinos (Latreille).

Hog Nose Snake.

Color when fresh, back above deep brown or umber with an almost imperceptible tinge of dull olivaceous. On each side of back, whole length of body, this color becomes a paler tint with a more olivaceous tinge, and by time middle of side or gastrosteges are reached it has a grayish tinge. Lower surface of body then a dull livid brownish-white. Head dull brown above, finely and inconspicuously specked with darker, and this color extending down to upper edge of upper labials. Lower surface of rostral pale like lower labials, or creamy-white, and upper surface brownish of general color of head above. Between eyes anteriorly a narrow deeper brown band, margined in front and behind with dusky. Behind eyes, including parietals and posterior end of front plates, a larger deeper brown area, which gives off a ramification behind on each side extending obliquely back, and all this distinctly with dusky. Medianly on occiput though not joined to last mentioned figure a median occiptal bar longitudinally of same colors, and together with afore-mentioned ramifications resolving into blackish of nape. In sutures at junction of frontal and parietal plates a small rounded pale brown spot of general color of head above, and with somewhat dusky margin. Posteriorly from eye below and sloping down to last upper labial, a deep brown bar margined dusky, and of about same width as those above. Down middle of back are 41 more or less regular ochraceous-brown oblique cross-bars, each one margined narrowly with a slightly paler tint inside and intervening deep brown blotches fusing into a dusky margin, so that they are very sharply defined. On tail they become more or less regularly transverse Along each side of trunk, about three scales above gastrosteges, ochraceous transverse oblique bars of back.

Mr. J. E. Richardson reports he found it near Sumner, Pine Hill and north of Point Pleasant in Camden county, and Garden Lake in Atlantic county.

Cemophora coccinea (Blumenbach).

PLATE 69.

Scarlet Snake.

Body slender, rigid and cylindrical. Gastrosteges 160 to 170. Color in life crimson, yellowish below, and about 20 to 26 black rings, each enclosing yellow one.

A small snake, abundant in Florida, and only known in our limits by Harlan's record, which has been overlooked by most writers. I omitted it in last year's report being under the impression that it was not definitely recorded from New Jersey limits. It is here mentioned simply to complete published information, however, open to question. Harlan says "inhabits South Carolina, feeding on grasshoppers and other insects. Received a specimen from Mr. B. Say, New Jersey, September, 1827." This does not leave it altogether clear that Say's specimen did come from New Jersey. However, the animal should perhaps be provisionally admitted to the fauna, as in the case of a number of others. It appears closely related to *Lampropeltis,* differing in the absence of the loreal plate and having fewer scales in a transverse series over the back (19 as compared with 21 to 25 in *Lampropeltis*).

Coluber coccineus Harlan, Med. Phys. Res., 1835 p. 119.

Family CROTALIDÆ.

Crotalus horridus Linnæus.

Rattlesnake.

Mr. J. A. G. Rehn has reports of a large one killed near Holmansville, in Ocean county, early in July of 1907, and another killed near New Gretna in Burlington county a little earlier. It is said to be local through northern Ocean county, between South Lakewood and Van Hiseville. Mr. Rehn also says they have not been seen about Stafford's Forge during the last 10

years. One was killed, according to reports, at Absecon, about 30 years ago. Mr. Charles Conner says they are reported to occur about Long Mountain in Burlington county, though none were seen. Mr. I. N. DeHaven reports one from Milford, in Camden county during the fall of 1907. Mr. S. H. Hamilton killed one in the early summer of 1905 at Poha Quarry in Warren county. One was reported to have been killed in the Great Cedar Swamp in the summer of 1907. I have credited this species to "Negocean," which is a slip for Goshen, in last year's REPORT.* Also at same place by an unfortunate slip, concerning Dr. Abbott's statement about this species, read "by hogs" and not "in bogs."

Family IGUANIDÆ.

Sceloporus undulatus (Latreille).

Pine Tree Lizard.

Seen at Green Creek on June 23d, 1907, while running about dead leaves. Mr. J. E. Richardson says he has seen it at Clementon, Albion, east of Sicklerville, and Sumner, in Camden county.

Family CHELONIIDÆ.

Caretta caretta (Linnæus).

Logger Head Turtle.

About Green Creek large sea turtles, evidently this species, are occasionally taken in the pounds. They are usually sold as food, according to the fishermen. One was reported, of moderately large size, to have been washed ashore at Ocean City during 1901.

Family CHELYDRIDÆ.

Chelydra serpentina (Linnæus).

Snapping Turtle.

Mr. S. H. Hamilton reports it from Woodport on Lake Hopatcong, where he saw a single example. Mr. J. E. Richardson reports a dark example he says he found half-way between Elwood and Batsto.

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[1] Rep. N. J. State Museum, 1906 (1907), p. 193.

Family KINOSTERNIDÆ.

Kinosternon pensylvanicum (Gmelin).

Mud Turtle.

Found near Pensauken in Burlington county on April 28th, 1907.

Terrapene odorata (Latreille).

Musk Turtle.

Found in the Rancocas Creek at New Lisbon, May 5th, 1907.

Family EMYDIDÆ.

Malaclemys centrata concentrica (Shaw).

Diamond Back Terrapin.

Reported to be taken frequently in the fall, on the salt-marshes, in the Great Egg Harbor Bay region, about Ocean City, Beesley's Point and Somers Point.

Pseudemys rubriventris (Le Conte).

Red Bellied Terrapin.

Young seen at New Lisbon in Burlington county on October 20th, 1907, by T. D. Keim and C. J. Hunt.

Chrysemys picta (Schneider).

Painted Terrapin.

Found in the Pensauken Creek, near Pensauken, Burlington county, on April 28th, 1907. Several found in a pond near Grenloch, Camden county, and others in a pond near Turnersville, Gloucester county, on May 19th, 1907. Two were seen at Toms River, Ocean county, on July 30th, 1907. Found at Mount

Hope, in Morris county, by Mr. S. H. Hamilton. Found in Mantua Creek at Wenonah, Gloucester county, on November 3d, 1907.

Clemmys insculpta (Le Conte).

Wood Tortoise.

Found at Oxford Furnace in Warren county in dry and open upland, by Mr. S. H. Hamilton. In captivity, an example fed on earthworms.

Clemmys guttata (Schneider).

Spotted Terrapin.

Found in the Rancocas Creek at New Lisbon, May 5th, 1907. Mr. S. H. Hamilton found it common at Mount Hope in Morris county. Mr. J. E. Richardson says he found it at Westville.

Didicla carolina (Linnæus).

Box Tortoise.

Found near Grenloch, in Camden county, May 19th, 1907. Several found at Green Creek on June 23d, 1907. They have an unfortunate habit of attempting to crawl across the roads, when they usually become entrapped in the wagon-ruts, out of which they do not seem to be able to escape, and are then often killed by passing teams.

Mr. S. H. Hamilton says that in his experience it is common on all the Watchung Mountains, not descending into the valleys. It occurs usually in forest land, and most always in heavy timber. He found it all through Scott's Mountain, Cherry Hill Lane, Orange Mountain, O'Rourke's Quarry to Milburn, and Oxford Furnace toward Washington, especially in Bethlehem Cut. They were preyed on by the skunks.

Mr. J. E. Richardson says he has found it at Clementon in Camden county.

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PLATES.

From Audubon & Bachman.

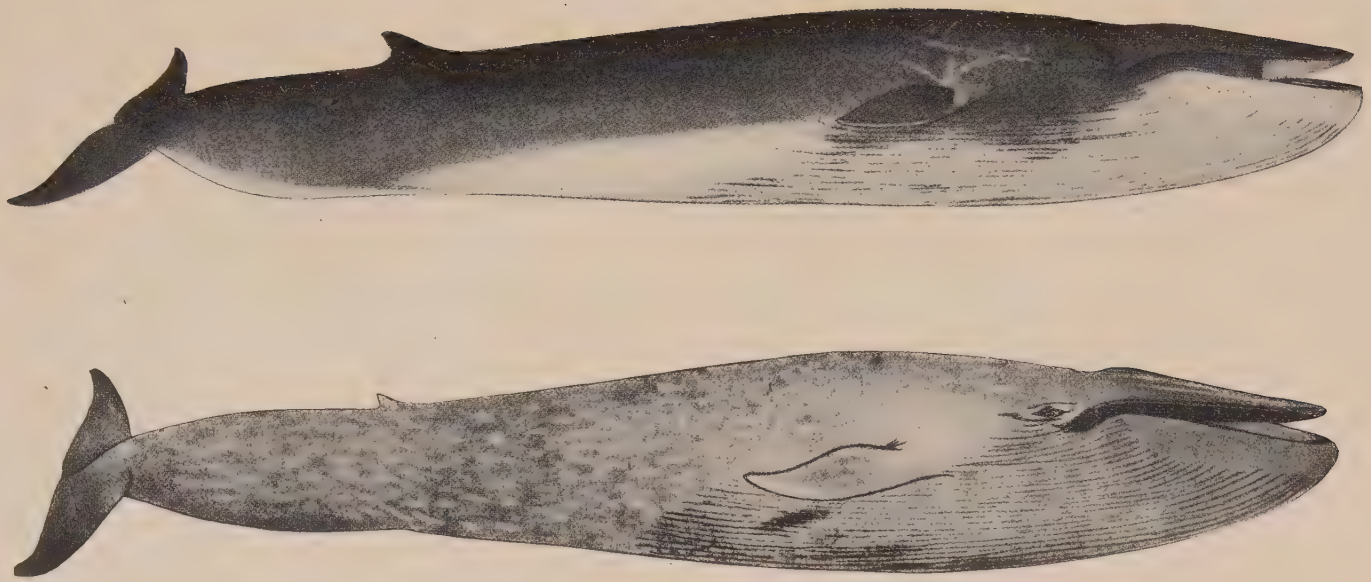
OPOSSUM. Didelphis virginiana Kerr.

From Smithson. Contr. XXXIII.

BLACK WHALE. Balæna glacialis Bonn.

From Smithson. Contr. XXXIII.

HUMP-BACKED WHALE. Megaptera nodosa (Bonn.).



From Smithson. Contr. XXXIII.

1. COMMON FIN-BACKED WHALE. Balænoptera physalus (Linn.).
2. SULPHURBOTTOM WHALE. Balænoptera musculus (Linn.).

From Smithson. Contr. XXXIII.

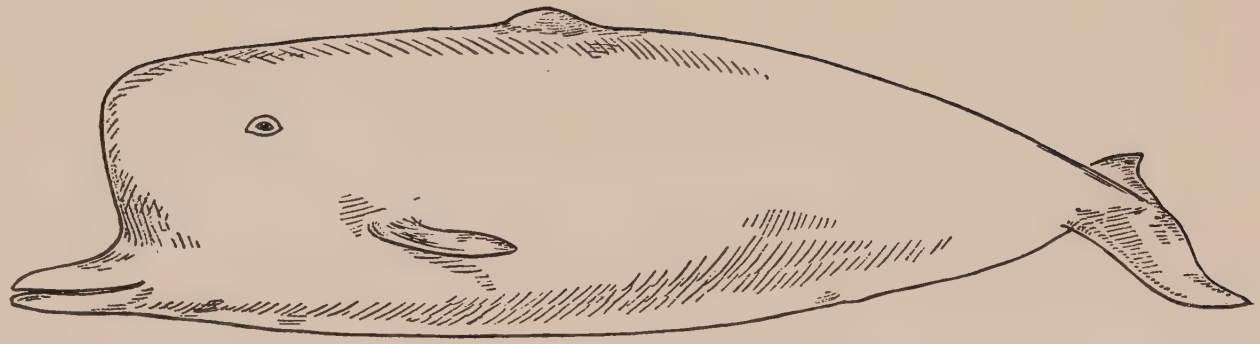
LITTLE PIKED WHALE. Balænoptera acuto-rostrata Lacep.

From Hist. Aquat. Animals, U. S. F. C.

SPERM WHALE. Physeter macrocephalus Linn.

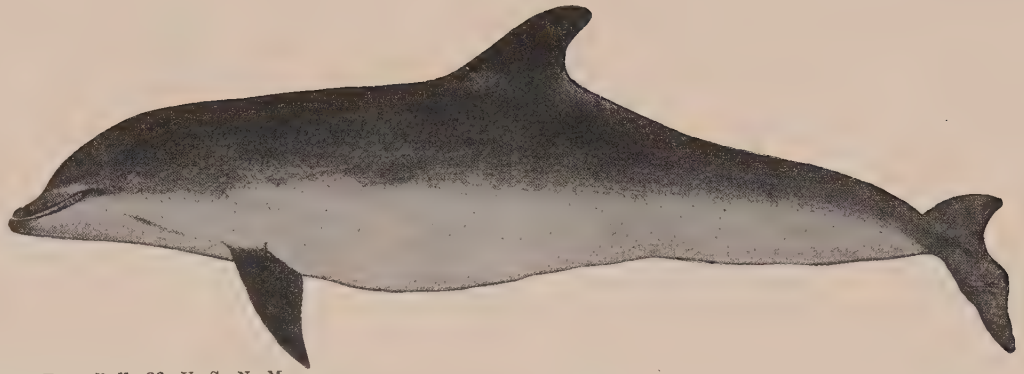
From Hist. Aquat. Animals, U. S. F. C.

PIGMY SPERM WHALE. Kogia breviceps (DeB.).



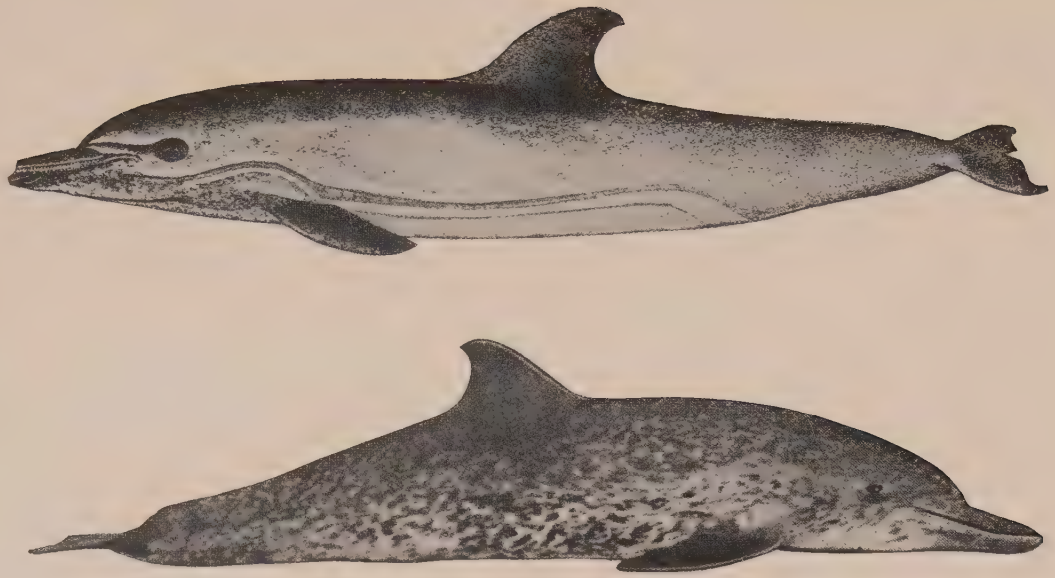
From Hist. Aquat. Animals, U. S. F. C.

BOTTLE-NOSED WHALE. Hyperoödon rostratus (Müll.).



From Bull. 36, U. S. N. M.

BOTTLE-NOSED DOLPHIN. Tursiops truncatus (Mont.).

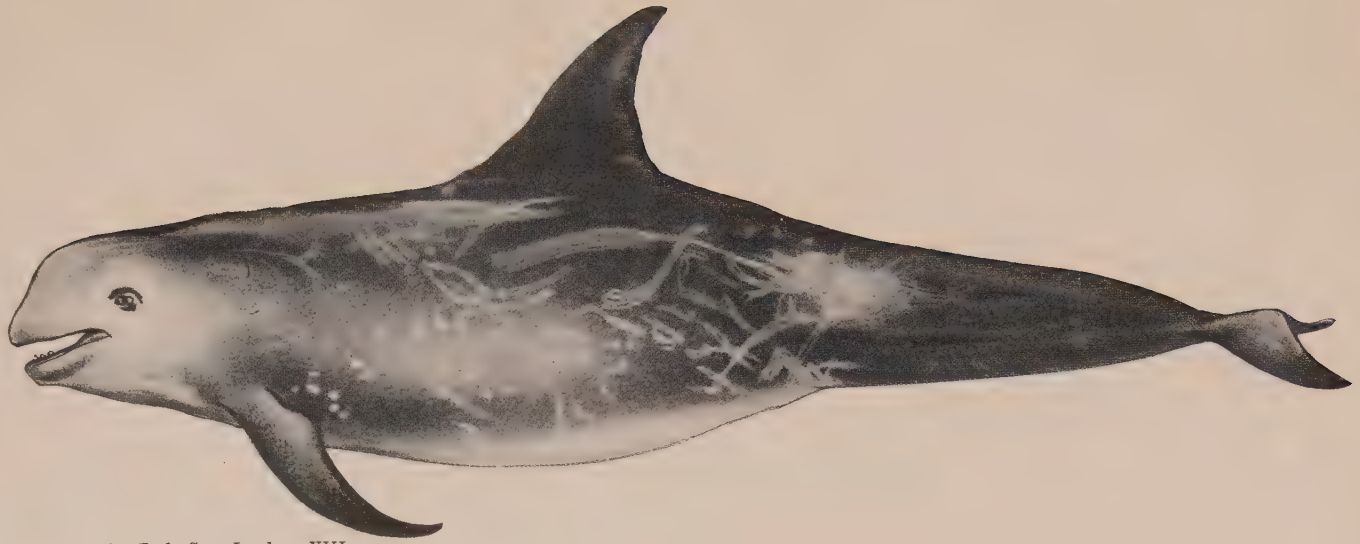


From Bull. 36, U. S. N. M.

1. COMMON DOLPHIN. Delphinus delphis Linn.
2. SPOTTED DOLPHIN. Prodelphinus plagiodon (Cope).

From Hist. Aquat. Animals, U. S. F. C.

BLACK FISH. Globicephala melas (Traill).



From Tr. Zool. Soc. London, VIII.

GRAMPUS. **Grampus griseus** (Cuv.).

From Bull. 36, U. S. N. M.

1. HARBOR PORPOISE. Phocæna phocæna (Linn.).
2. KILLER. Orcinus orca (Linn.).

From Audubon & Bachman.

VIRGINIA DEER. **Odocoileus virginianus** (Bodd.).

From Audubon & Bachman.

VIRGINIA DEER. **Odocoileus virginianus** (Bodd.)—Fawn.

From Audubon & Bachman.

COTTONTAIL. Lepus floridanus mallurus (Thomas).

From Audubon & Bachman.

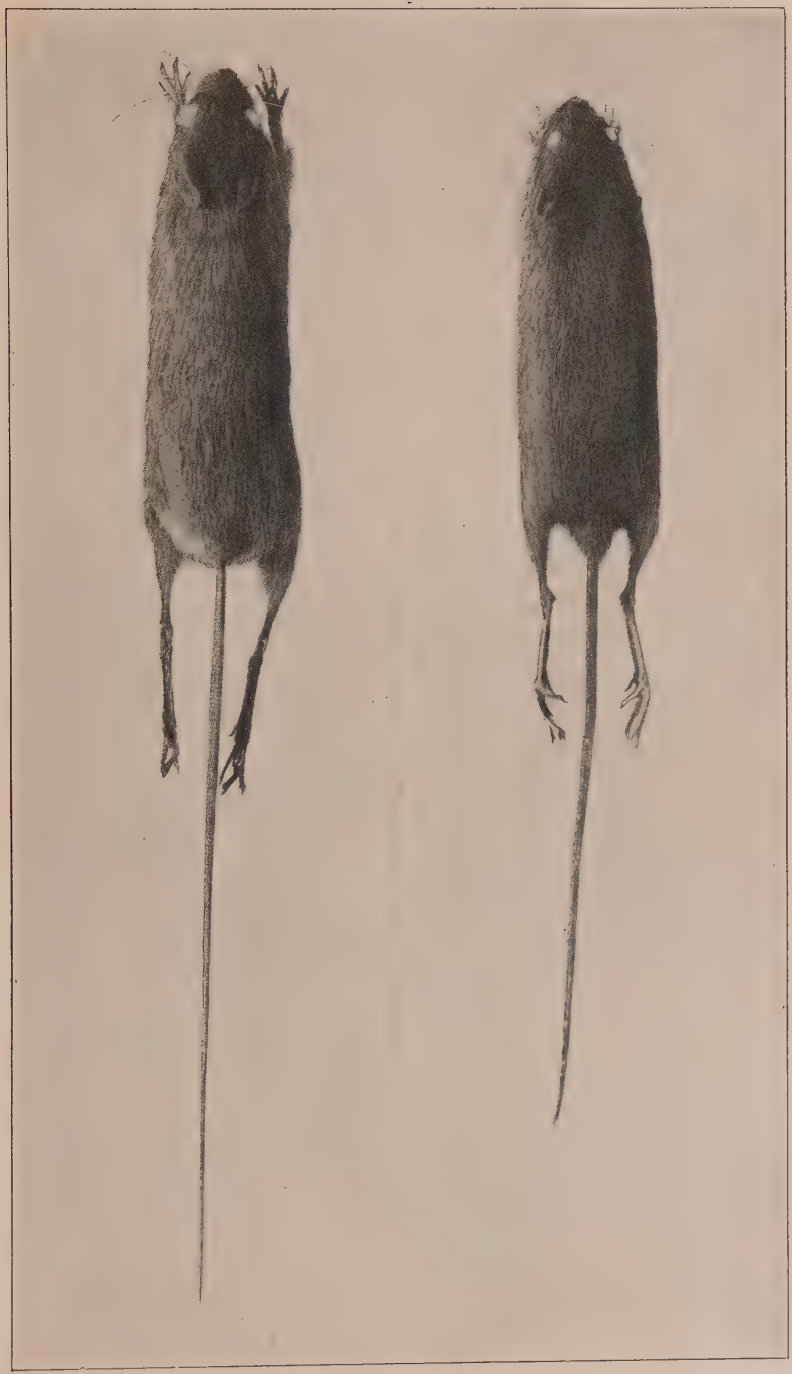
VARYING HARE. **Lepus americanus virginianus** (Harlan).

From Audubon & Bachman.

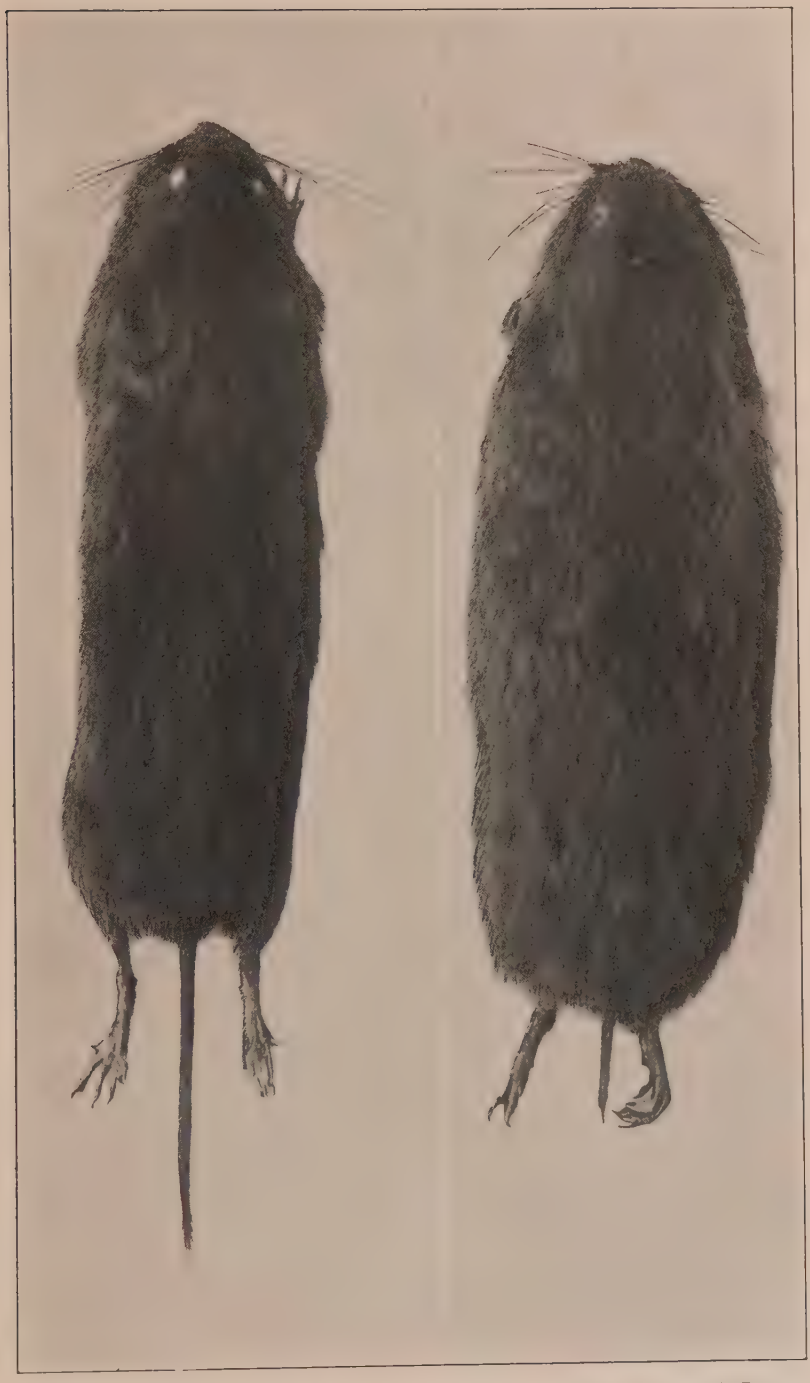
CANADA PORCUPINE. Erethizon dorsatus (Linn.).

From Audubon & Bachman.

MEADOW JUMPING MOUSE. Zapus hudsonius (Zimm.).



1. WOODLAND JUMPING MOUSE. Zapus insignis Miller.
2. MEADOW JUMPING MOUSE. Zapus hudsonius (Zimm.). } ⅔ Nat. Size.



1. RHOADS' RED-BACKED MOUSE. Evotomys gapperi rhoadsi Stone.
2. COOPERS' LEMMING MOUSE. Synaptomys cooperi Baird.

Natural Size.

From Audubon & Bachman.

MEADOW MOUSE. Microtus pennsylvanicus (Ord.).

From Audubon & Bachman.

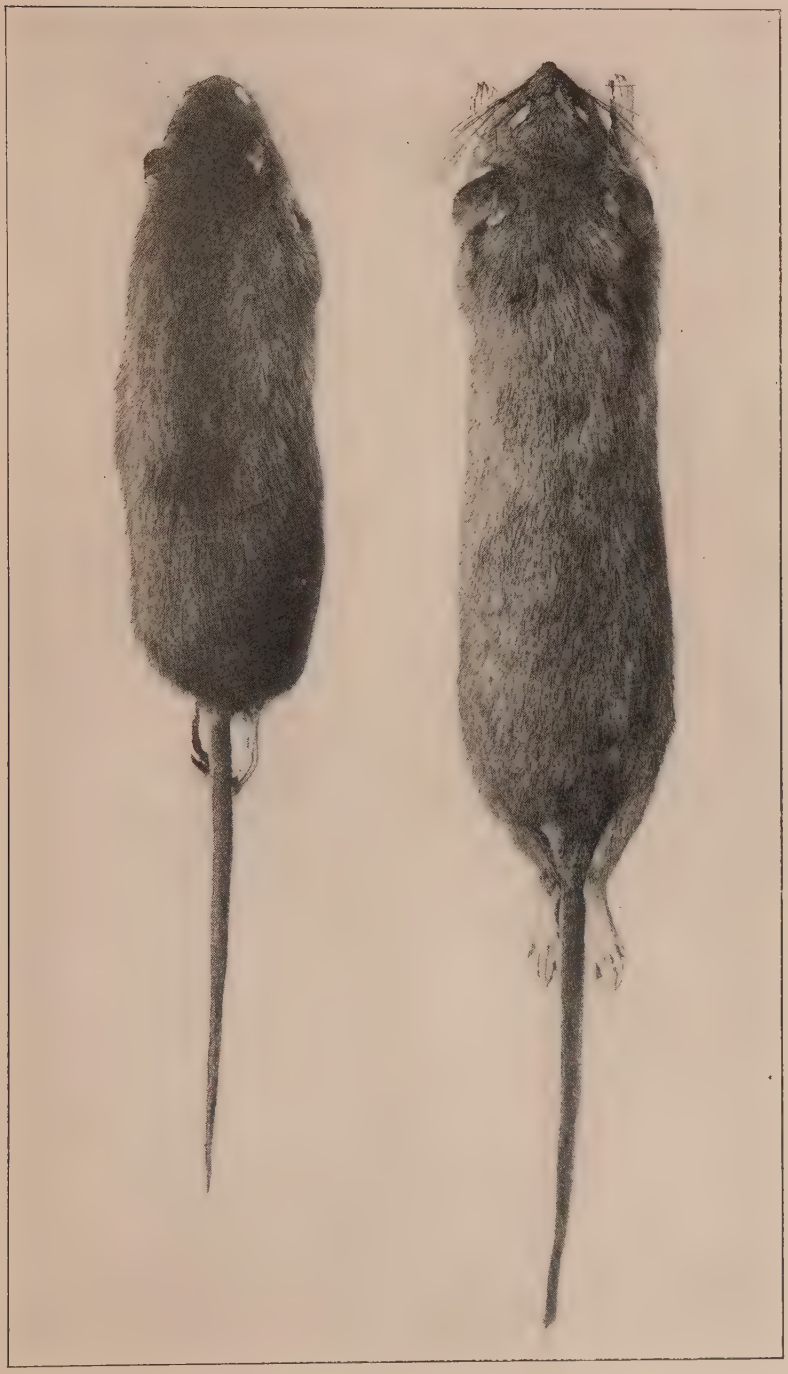
NORTHERN PINE MOUSE. **Microtus pinetorum scalopsoides** (Aud. & Bach.).

1. MEADOW MOUSE. Microtus pennsylvanicus (Ord.).
2. NORTHERN PINE MOUSE. Microtus pinetorum scalopsoides (Aud. & Bach.).

Natural Size.

From Audubon & Bachman.

MUSKRAT. **Fiber zibethicus** (Linn.).



1. NORWAY RAT. Mus norvegicus Erxl.
2. ALLEGHANY WOOD RAT. Neotoma pennsylvanica Stone.

2/5 Natural Size.

RICEFIELD MOUSE. **Oryzomys palustris** (Harlan).
⅔ Natural Size.

From Audubon & Bachman.

WHITE-FOOTED MOUSE. Peromyscus leucopus (Raf.).

1. HOUSE MOUSE. Mus musculus Linn.
2. WHITE-FOOTED MOUSE. Peromyscus leucopus (Raf.).

From Audubon & Bachman.

HOUSE MOUSE. **Mus musculus** Linn.

From Audubon & Bachman.

NORWAY RAT. Mus norvegicus Erxl.

From Audubon & Bachman.

BEAVER. **Castor canadensis** Kuhl.

From Audubon & Bachman.

WOODCHUCK. Marmotta monax (Linn.).

From Audubon & Bachman.

FRANKLIN'S SPERMOPHILE. *Citellus franklini* (Sab.).

From Audubon & Bachman.

CHIPMUNK. Tamias striatus (Linn.).

From Audubon & Bachman.

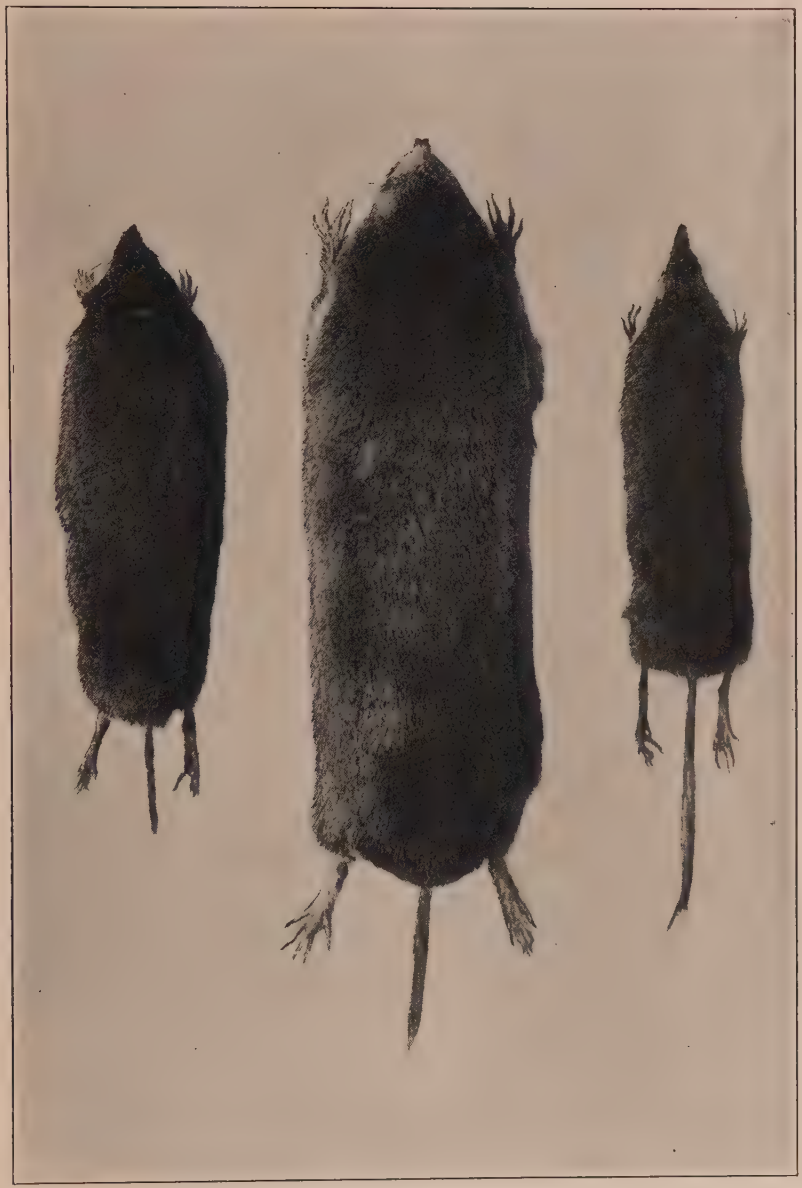
GRAY SQUIRREL. **Sciurus carolinensis** Gm.

From Audubon & Bachman.

SOUTHERN RED SQUIRREL. Sciurus hudsonius loquax Bangs.

From Audubon & Bachman.

FLYING SQUIRREL. Sciuropterus volans (Linn.).



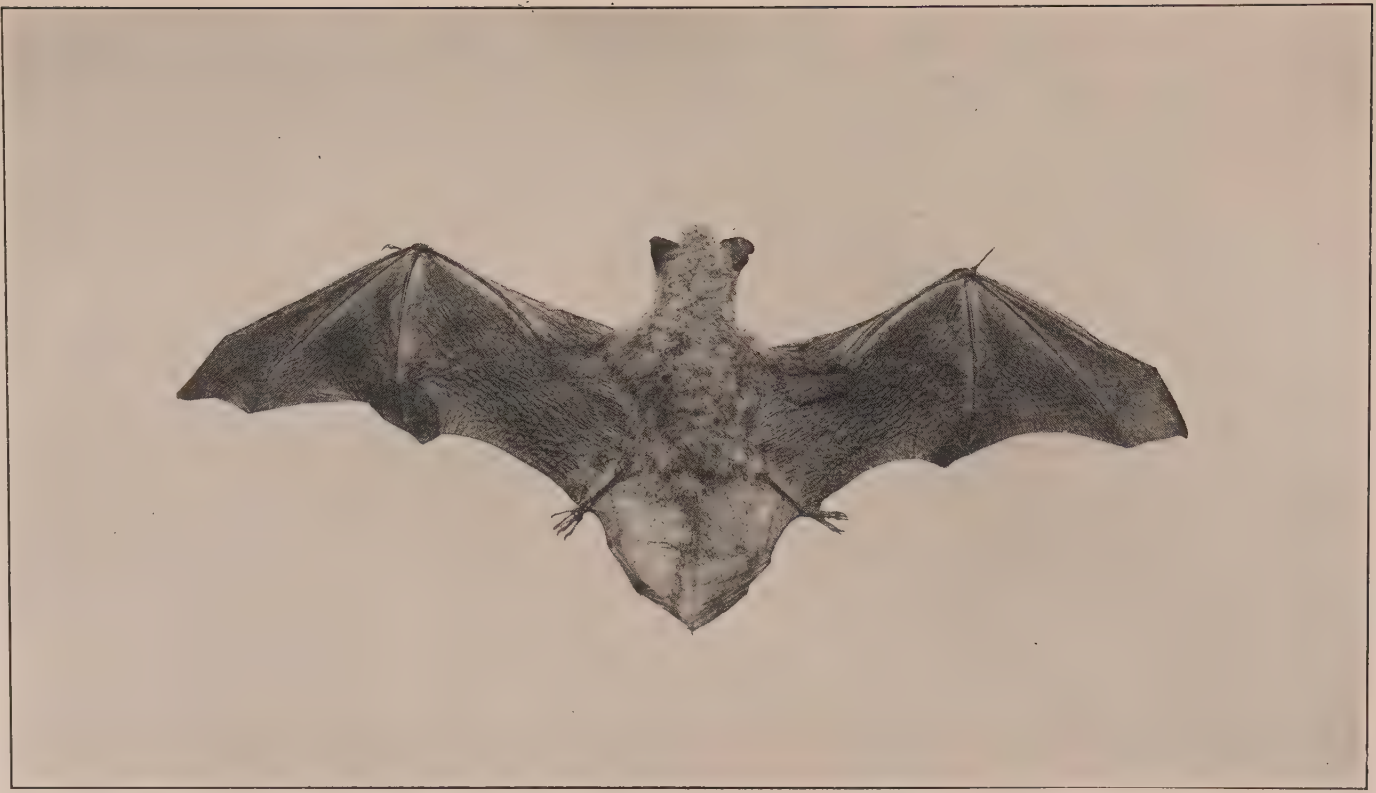
1. BROWN SHREW. Blarina parva (Say).
2. SHORT-TAILED SHREW. Blarina brevicauda (Say).
3. LONG-TAILED SHREW. Sorex personatus Geoff.

Natural Size.

1. NAKED-TAILED MOLE. Scalops aquaticus (Linn.).
2. BREWER'S MOLE. Parascalops breweri (Bach.).
Nearly Natural Size.

STAR-NOSED MOLE. Condylura cristata (Linn.).
Natural Size.

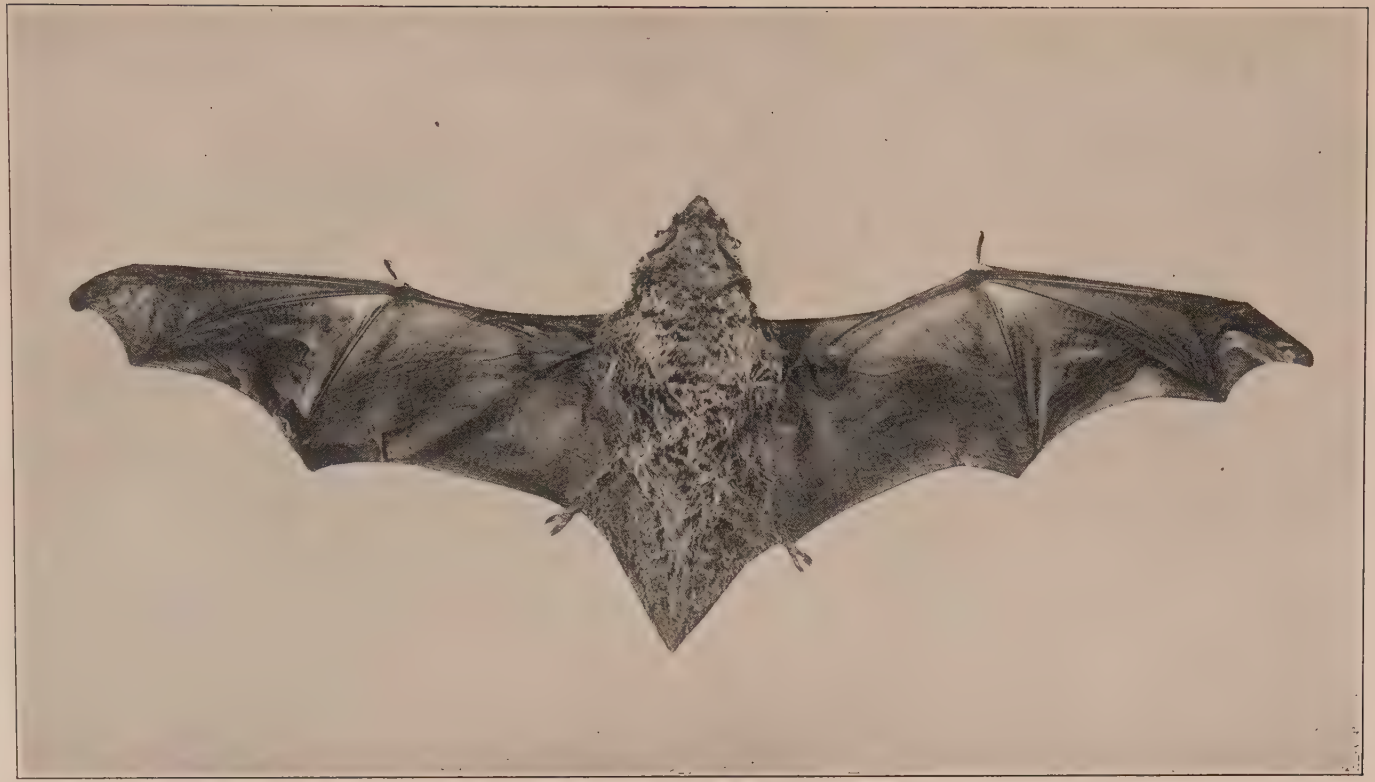
LARGE BROWN BAT. **Vespertilio fuscus** Beauv. ½ Natural Size.



GEORGIA BAT. **Pipistrellus subflavus** (Cuv.). ⅔ Natural Size.

SILVER-HAIRED BAT. Lasionycteris noctivagans (LeConte). ⅔ Natural Size.

RED BAT. Lasiurus borealis (Müll.). ⅔ Natural Size.



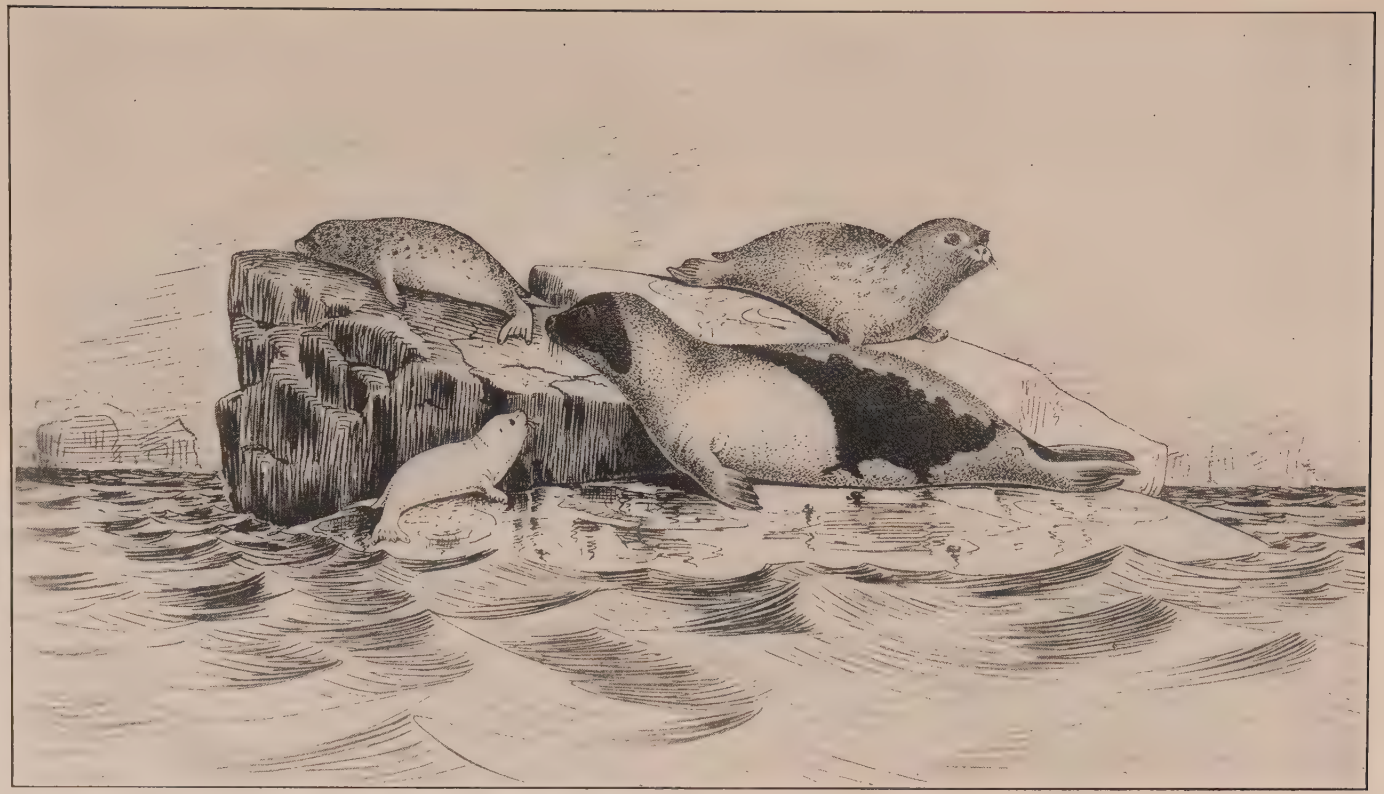
HOARY BAT. **Lasiurus cinereus** (Beauv.). ⅔ Natural Size.

From Hist. Aquat. Animals, U. S. F. C.

HOODED SEAL. Cystophora cristata (Erxl.).

From Hist. Aquat. Animals, U. S. F. C.

HARBOR SEAL. Phoca vitulina (Linn.).



From Hist. Aquat. Animals, U. S. F. C.

HARP SEAL. Phoca groenlandica (Erxl.).

From Audubon & Bachman.

CAROLINA OTTER. **Lutra canadensis lataxina** (Cuv.).

From Audubon & Bachman.

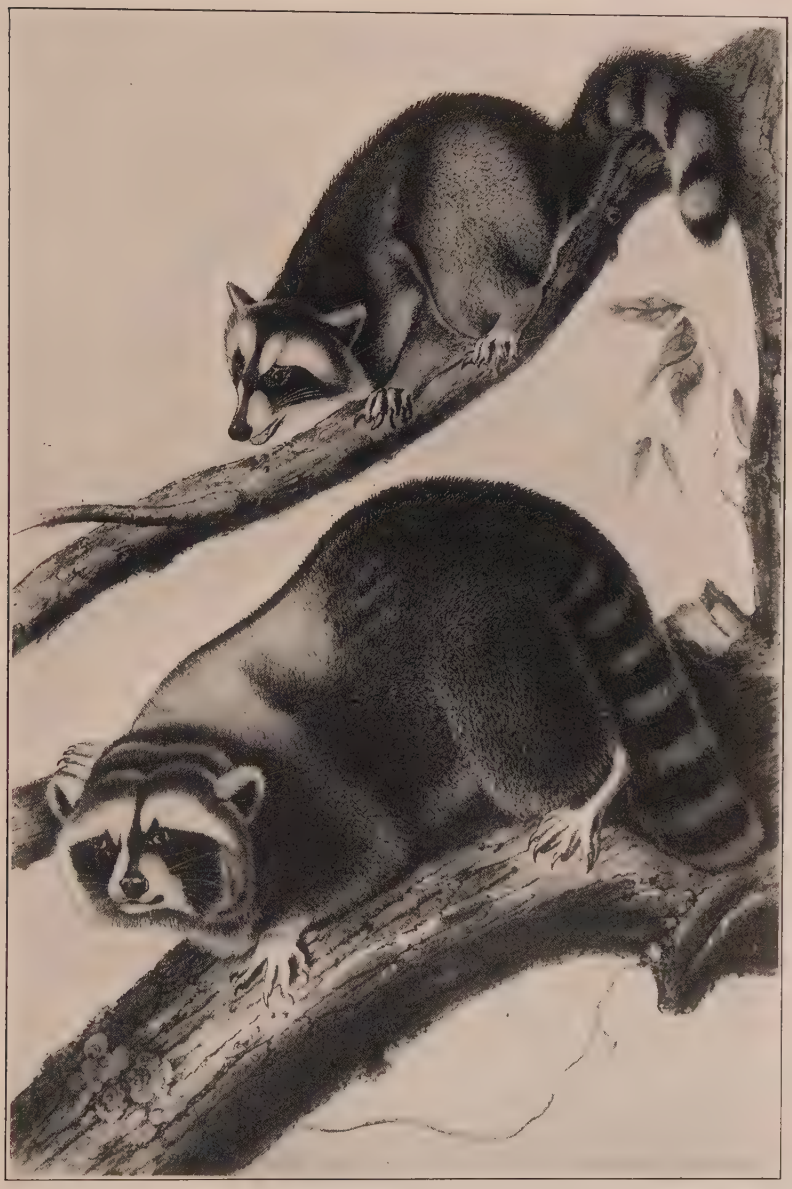
EASTERN SKUNK. **Mephitis mephitica putida** (Cuv.).

From Audubon & Bachman.

SOUTHERN MINK. Putorius vison lutreocephalus (Harlan).

From Audubon & Bachman.

NEW YORK WEASEL. Putorius noveboracensis (Emmons).



From Audubon & Bachman.

RACCOON. **Procyon lotor** (Linn.).

From Audubon & Bachman.

RED FOX. Vulpes fulvus (Desm.).

From Audubon & Bachman.

GRAY FOX. Urocyon cinereoargenteus (Schreb.).

From Audubon & Bachman.

WILD CAT. **Lynx ruffus** (Guld.).

KING CRABS.

A King Crab Pound along the Delaware Bay shore of Cape May County.

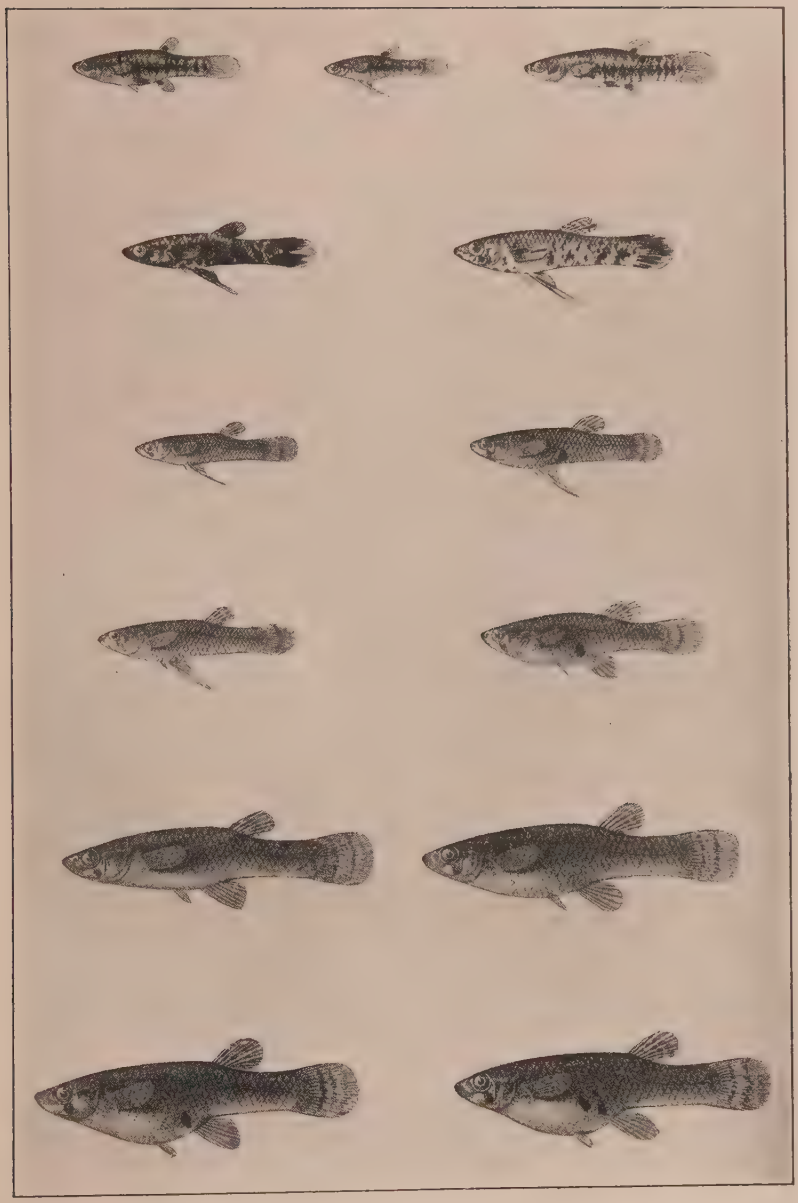
A small King Crab pen.

A near view of a moderate-sized King Crab pen.

View of a moderate-sized King Crab pen.

View of a very large King Crab pen.

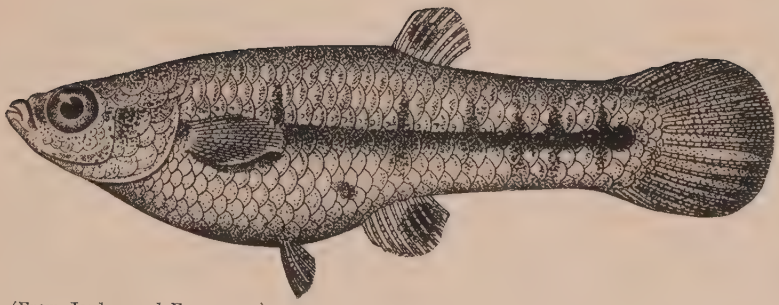
View of a very large King Crab pen as seen from above.



(From Garman.)

TOP MINNOWS.

Upper three figures Heterandria formosa Agassiz, and the others all Gambusia gracilis (Heckel).

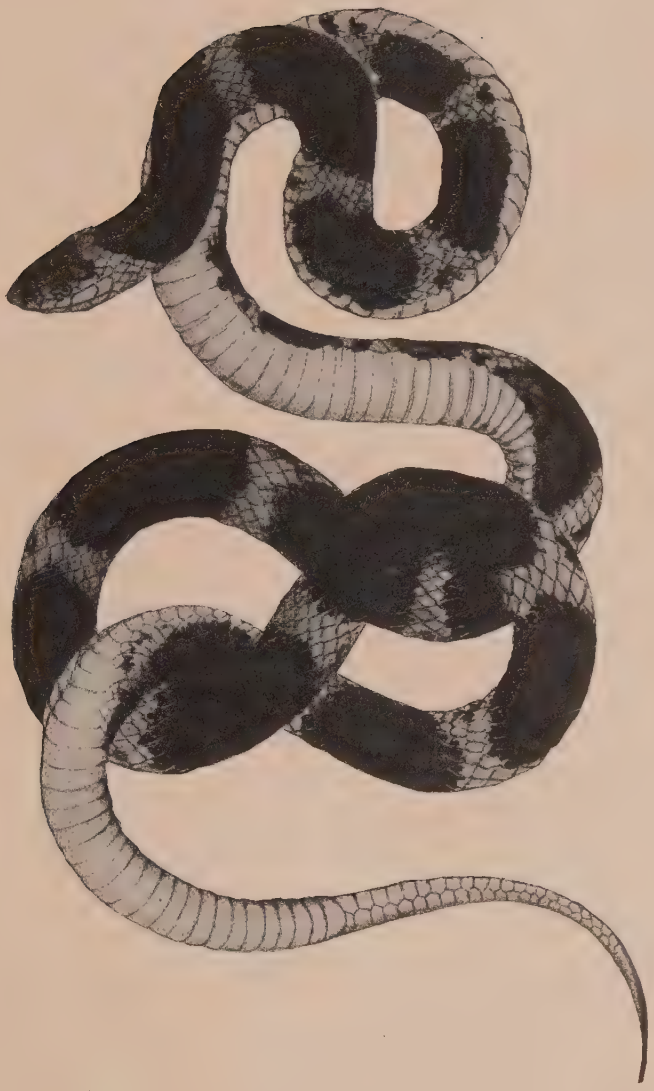


(From Jordan and Evermann.)

TOP MINNOW. Heterandria formosa Agassiz.

(From Evermann and Marsh.)

SOUTHERN PUFFER. **Spheroides testudineus** (Linnæus).



(From Holbrook.)

SCARLET SNAKE. Cemophora coccinea (Blumenbach).